

ELECTRONICS

Australia

Bangs
August, 1968

Incorporating RADIO, TELEVISION & HOBBIES

Vol. 30 No. 5



30c

NUMERICAL CONTROL OF MACHINES

- Computerising an airline • Wide-band AM tuner
- Transistor tester • A simple stereo amplifier

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Incorporating "RADIO, TELEVISION and HOBBIES"

ABC certified circulation in excess of 47,000.

Volume 30, No. 5

Editor:
NEVILLE WILLIAMS, M.I.R.E.E. (Aust.)
(VK2XV).

Assistant Editor:
PHILIP WATSON, A.M.I.R.E.E. (Aust.)
(VK2ZPW).

Technical Editor:
JAMIESON ROWE, B.A. (Syd.), B.Sc.
(Technology, N.S.W.), A.M.I.R.E.E.
(Aust.).

Technical Staff:
IAN POGSON (VK2AZN),
ANTHONY LEO (VK2ZHk),
HARRY TYRER,
JOHN HORSFIELD,
ROBERT FLYNN,
LEO SIMPSON.

Editorial Office:
12th Floor, 235-243 Jones Street,
Broadway, Sydney, Australia. Phone
2-0944, Ext. 2531, 2525-6-7.

Postal Address:
Box 2728, G.P.O., Sydney, 2001, Australia.

Advertising:
SELWYN SAYERS, Mgr.
BILL SUMMONS, Rep., Sydney.
Offices: 8th Floor, 235-243 Jones Street,
Broadway, Sydney, Australia. Phone
2-0944, Ext. 2931, 2508, 2943.
CLARRIE LEVY, Rep., Melbourne, 392
Little Collins Street, 3000. Ph. 67-8131.

Circulation:
A. PARKER, Mar.
Offices: 9th Floor, 235-243 Jones Street,
Broadway, Sydney, Australia. Phone
2-0944, Ext. 2505, 2509.

Subscription Rates—See back page.

Representation:
Melbourne—John Fairfax & Sons Ltd.,
392 Little Collins St., 3000. Ph. 67-8131
Brisbane—Sungravure Pty. Ltd., 78
Elizabeth Street, 4000. Ph. 2-6688.
Adelaide—John Fairfax & Sons Ltd.,
104 Currie Street, 5000. Ph. 51-3502.
Perth—Sungravure Pty. Ltd., 847 Hay
Street, 6000. Phone 23-4513.

Newcastle, N.S.W.—Associated Newspapers Ltd., 22 Bolton Street, 2300.
Phone 2-3696.

London—John Fairfax & Sons (Aust.) Ltd., Reuter Building, 85 Fleet Street.
New York—"The Sydney Morning Herald" Ltd., "Times Annex," 229 West
43rd Street.

Distribution:
Distributed in N.S.W. by Sungravure
Pty. Ltd., Jones St., Broadway, Sydney.
N.S.W.; in Victoria by Sungravure Pty.
Ltd., 392 Little Collins Street, Melbourne;
in South Australia by Sungravure
Pty. Ltd., 194 Currie Street, Adelaide;
in Western Australia by Western
Press; in Queensland by Gordon and Gotsch (Qld) Ltd.; in New
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Modules for colour TV

While the Australian Government has not yet made a firm announcement about colour television, Australian receiver designers are nevertheless thinking, planning and working against the day when their first colour sets will begin to roll down the production lines. It is to be hoped, however, that the sets will not turn out to be a mere elaboration of present-day concepts.

This is not meant as a depreciation of current model monochrome receivers. They are efficient and reliable enough but, for the most part, they carry on the techniques of the "radio" era. They are built as composite units, intended to exist and be serviced as such. They have valves to change, presets to adjust, small components made easily accessible for ease of replacement. They depend on the assumption that any faults which occur will be individually diagnosed and corrected by servicemen in the field or on the bench.

The weakness of this assumption is that many practising servicemen are hard put to it to cope with the technical challenge so presented and there is no doubt that many faults yield, not to informed analysis, but to procedures which somehow seem to fix them. Nor is there any doubt that many existing receivers are operating well below their intended level of performance.

This sort of approach will simply not be good enough for colour television. With all the additional and critical circuit functions, the result of unskilled fiddling can be catastrophic in terms of picture quality. It will not be good enough just to keep colour receivers "going"; they will have to be maintained at a reasonable level of efficiency — and this will involve extra skill, extra time and extra equipment.

Short of a substantial — and improbable — escalation of service capabilities, the only practical answer is a completely new generation of receivers employing modular construction. Basically, servicemen will be required to locate and replace faulty modules, the faulty units being returned to the factory for reprocessing, using factory skills and equipment.

Overseas, the problems of servicing by traditional methods have been discovered the hard way and it is hoped that Australian designers will opt for modular techniques, right from the outset.

W. N. Williams

August, 1968

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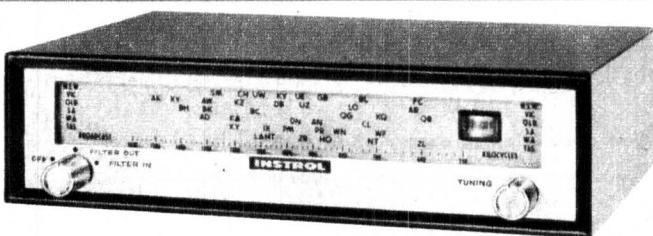
COVER PICTURE: Extensive use is being made by Rolls-Royce of numerically controlled machine tools. Capable of being readily integrated with computer systems, the machines yield faster, cheaper production with lower spoilage—an important factor when expensive materials are involved.

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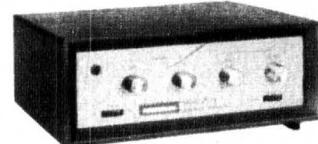


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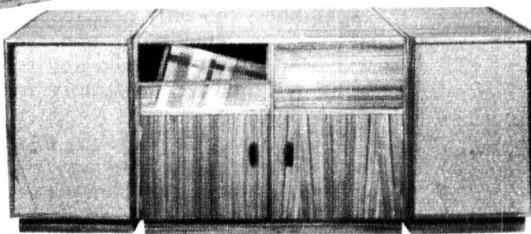
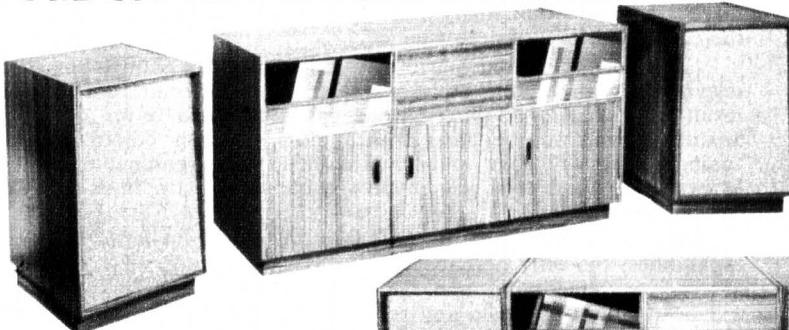


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20-20 AMP' (in Teak Case)	\$99.00
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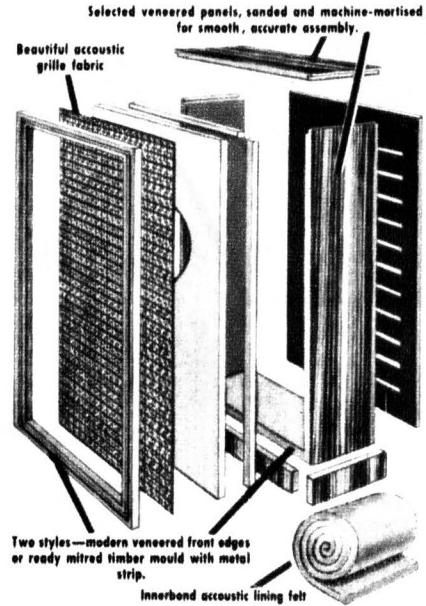
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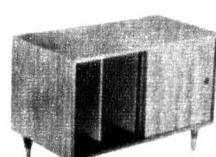
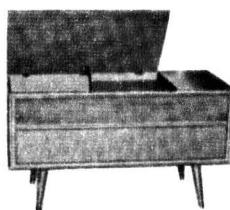
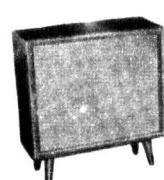
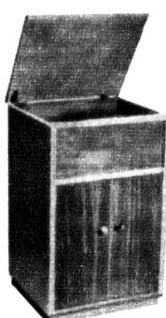


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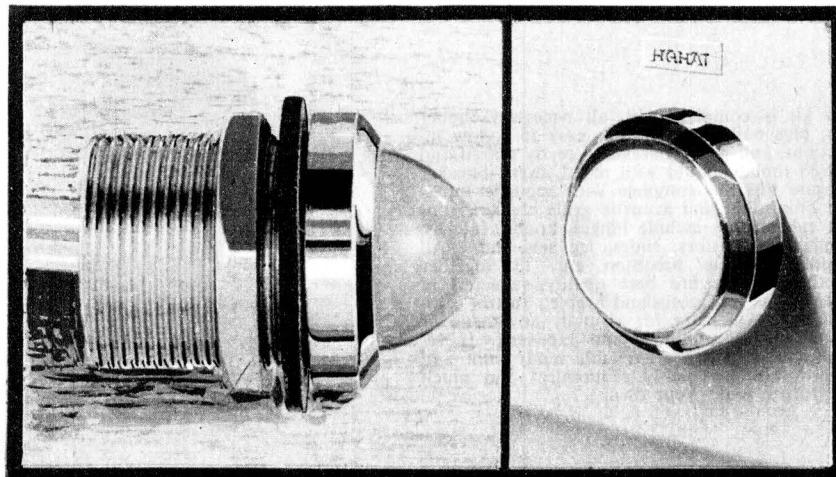
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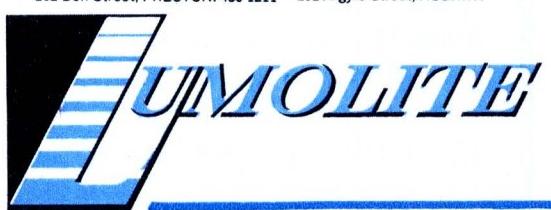
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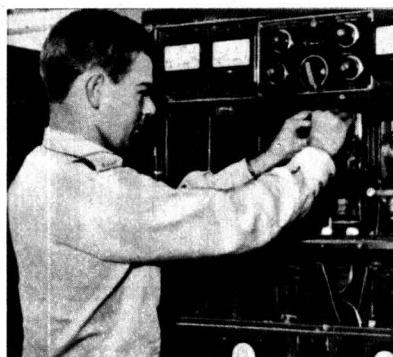
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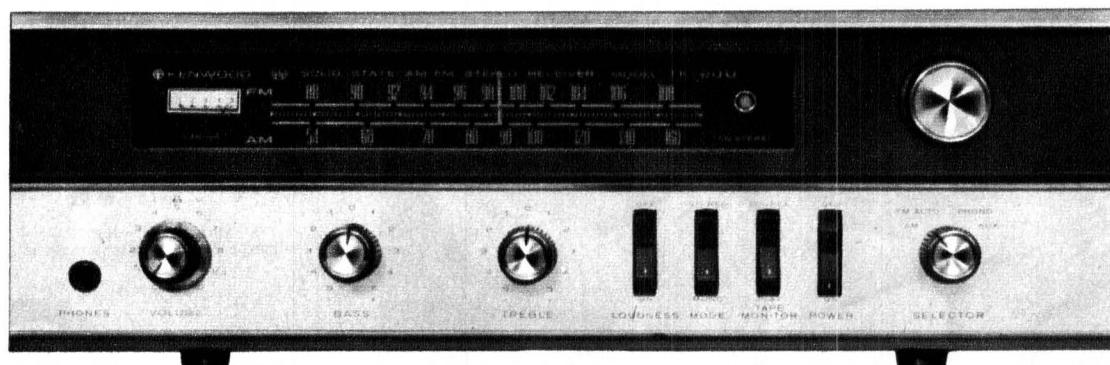
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▼ TK-20U

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*5 IF stages with 3 limiters and wideband ratio detector have been incorporated to provide 40dB alternate channel selectivity and freedom from noise and interference.

*4-position program source selector permits AM, FM AUTO, PHONO and AUX.

*USABLE SENSITIVITY:

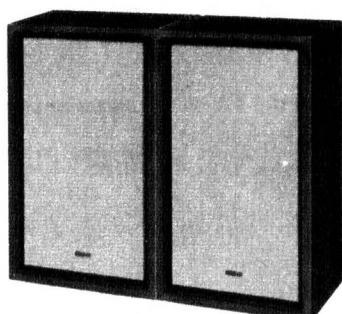
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*TOTAL MUSIC POWER:

32 watts (IHF Standard at 4 ohms)
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*FREQUENCY RESPONSE: 25 Hz—40,000 Hz

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▼ KL-60

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▼ TK-150U

- *40 watts of IHF Standard total music power
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60 WATTS SOLID STATE STEREO AMPLIFIER TK-250U

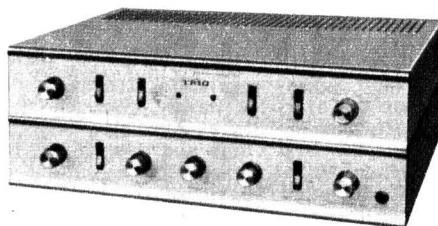


▼ TK-250U

- *60 watts of IHF Standard total music power
- *Very low IM distortion for exceptional clear sound low level to high level listening
- *High damping factor 23 (8 ohms), 46 (16 ohms) for excellent transient response
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90 WATTS SOLID STATE STEREO AMPLIFIER TK-400T

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▼ TK-400T

- *90 watts of IHF Standard total music power to drive even low efficiency Hi-Fi speakers.
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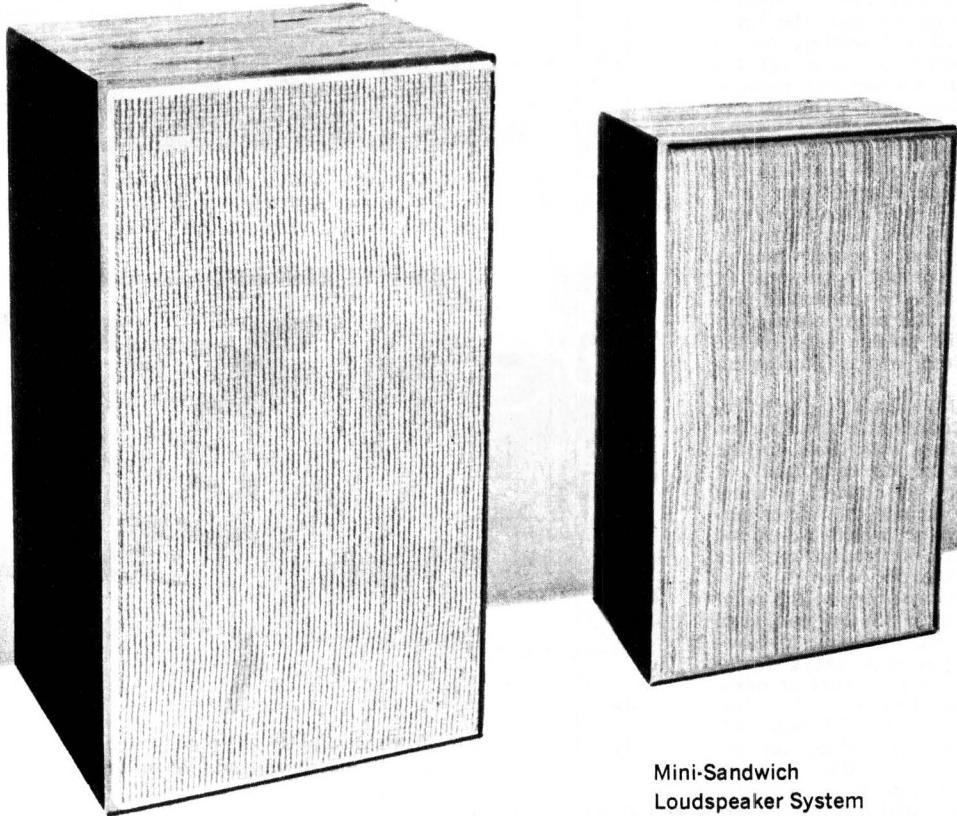
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LEAK HI-FI

have been chalked up in world airline operation. B.E.A. was the first airline to employ a prop-jet airliner to carry fare-paying passengers — the Vickers Viscount 630.

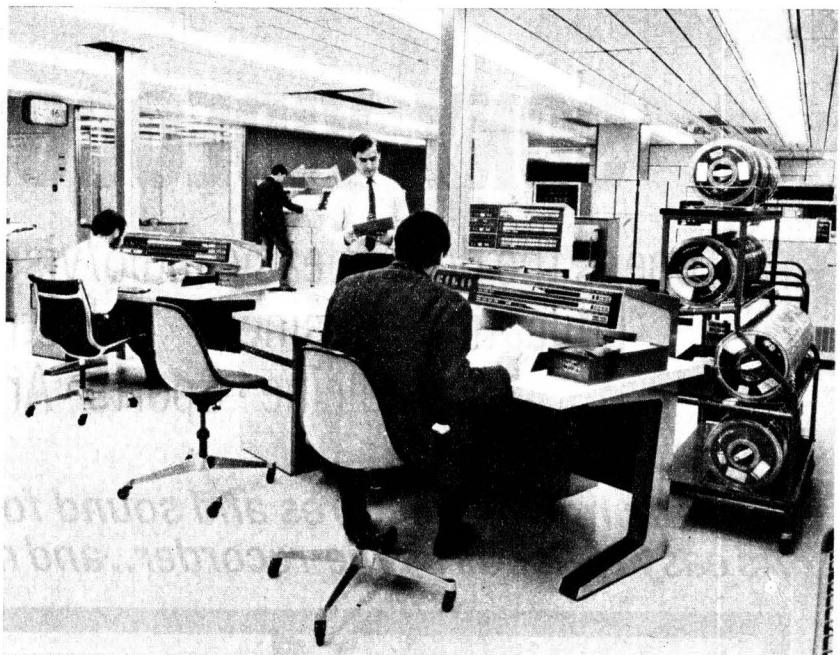
It was the first airline in the world to introduce automatic touchdowns in scheduled passenger services (in June, 1965). Although certification has not yet been granted for fully automatic landing in visibility below normally prescribed limits, an airliner has been fitted with standard equipment officially approved for automatic landing. This airliner is in day-to-day scheduled operation.

Most significant of all, perhaps, the airline has progressed further than any other in the world in planning towards a complete streamlining of its whole operation, by the use of computers.

One of the more difficult commercial problems facing any airline is the provision of a seat-reservation system that books the maximum possible number of seats on its flights without selling the same seat twice.

This problem was not insuperable in times when both flights and passengers were few. In those days pencil and paper booking methods coped adequately with the traffic. As air travel grew, manual methods were developed and refined and sophisticated communications equipment was brought in to help, but the crux of the problem remained a manual filling in and filing of cards with frequent reference to wall boards to check the availability of seats; and all this combined with exacting mental arithmetic by the booking clerks.

The magnitude of the problem can be assessed statistically. Every year, B.E.A. offers 12 million seats on 158,000 flights over more than 100 European routes. At the average fare per passenger journey of nearly £10, just one seat lost on each flight would have



Control facilities at the BEACON computing centre.

turned B.E.A.'s net profit for 1966 of £0.7 million into a loss of about the same amount. Consider this against the fact that seat sales are made through approximately 1,000 retail outlets in Britain, 3,000 more in Europe, and several thousand more throughout the rest of the world.

By the end of the 1950s it had become clear that, if B.E.A.'s system was to keep pace with its growth, more than a mere multiplication of booking staff, or revision of the existing system would be needed. The B.E.A. Board accordingly ordered a study of computers.

These studies, begun in 1959 by a full-time systems analysis team, ag-

gregated 15 man-years. They were able to show that certain minor difficulties could be overcome by the introduction immediately of routine data processing systems in accounting, sales analysis, and payroll and stock control. Accordingly, these typical "batch" processing tasks were computerised in 1962.

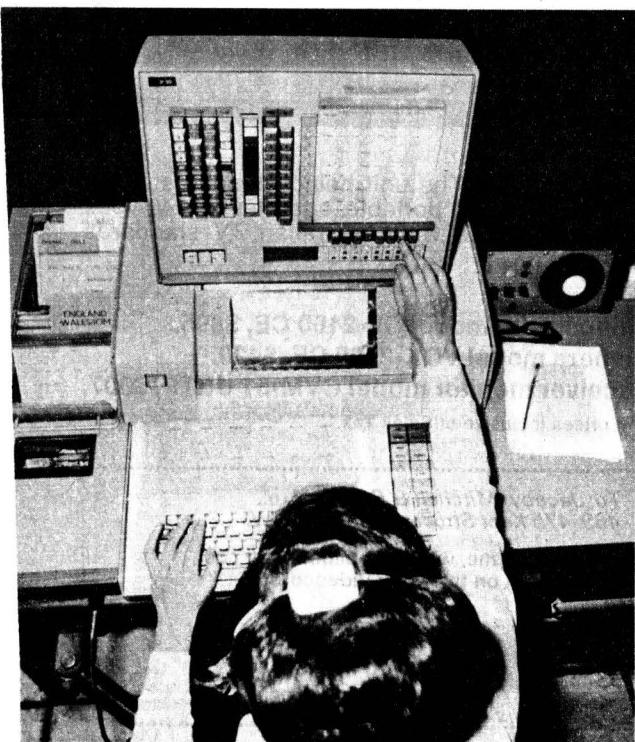
The more complicated seat-reservation operation needed further research, and it was not until April, 1963, that Sperry Rand's Univac Division was selected to manufacture the hardware required. Two Univac 490 real-time computers were installed in the West London Air Terminal in September 1964 and in April 1965—16 minutes ahead of schedule—Stage I of the automatic system was cut over.

This system occupies more than half an acre on two floors at the terminal. The computers are housed with magnetic drum and magnetic tape storage in a 6,500 sq. ft. dustproof, air conditioned room. A 420-line telephone switchboard is accommodated on the same floor.

The floor above, the vast 22,000 sq. ft. reservations hall — one of the world's largest automated offices — contains some 250 Univac UNISET interrogation devices operated by reservations sales assistants who speak directly with the public by telephone.

The first interim stage of the system — from April 1965, to November 1966 — operated as an "inventory system," the central computer holding in storage counts, or inventories, of seats already booked and those still available for sale on each flight. The availability of seats is selected for display on the clerk's enquiry set. He then presses keys to record the number of seats booked or cancelled. The computer adjusts the inventory instantaneously.

This first stage of mechanisation was outstandingly successful, enabling the public to be given a faster and more accurate service. It also lifted the burden of arithmetic from the control staff and allowed wall boards to be dispensed with. However, at that stage,



One of the Univac UNISET reservations devices operated by B.E.A., as used in their main reservation centre and in booking offices in the major cities of Britain, Scotland and Northern Ireland. Having experienced the effectiveness of the system at first hand, the Editor arranged for rights to publish this article.

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the computer only controlled seat numbers. Passengers names and related data were still recorded manually.

Both equipment and programs had, however, been designed to progress from this point to two further stages of development. The introduction of the second stage, known as the "Passenger Name Record" system, was completed by November, 1966. The computer now stores not only the inventory of seats, but also the passenger details.

Each clerk's set is equipped with a teletypewriter keyboard through which the records of new passengers are entered directly into the system. The computer builds up separate "control charts" for each flight within its own drum storage. At the same time, the programs have been so written that the number of seats booked from the inventory must be balanced by the number of names entered through the teletypewriter keyboard.

If a passenger telephones to alter a reservation, any sales assistant can retrieve the name from the computer's storage within about a second by typing in the passenger's name and any of the flights on which he is booked. The computer searches its storage for the record and prints it out at the assistant's position, where he can make the required alterations and instruct the computer to refile the record.

What this has meant in terms of economy of effort and of finance can be assessed by considering that B.E.A. receives 12,000 telephone calls a day, of which 2,000 are regularly received at the peak hour. In the days of manual operation, each telephone call lasted an average of slightly over five minutes. The saving of a minute or two each call thus not only increases efficiency and potential capacity, but also reduces operating costs.

Besides telephone calls, some 18,000 teletypewriter messages flood in daily from selling points in Great Britain and overseas in search of attention. In the days of manual handling, some delay was unavoidable in giving these messages the required response.

However, the messages now in code are switched automatically into the computer, which makes and records the booking and reports back to the originator on the action it has taken. Timed messages from Cyprus have received an answer returned from the computer in less than three minutes and from centres such as the one at Leeds in 45 seconds.

The new system has eliminated all hand-written records, manual transcription, and card filing; and the reservation staff has been freed to give closer attention to the essentially human aspects of the work.

Over and above installation in airline offices, B.E.A. is currently looking into the possibility of offering direct access to the BEACON Centre to travel agents throughout the United Kingdom—a scheme which is likely to anticipate any similar provision by other European carriers by about five years. Since an IATA resolution prohibits an individual airline from underwriting such installations, travel agents would have to bear the cost of installation, maintenance and lines—estimated at about £800 per annum.



B.E.A.'s Reservations Hall has a floor area of 22,000 square feet and houses nearly 250 Univac UNISET interrogation devices, manned by operators who deal directly by telephone with the public.

Finally, the third stage of the BEACON (B.E.A. Computer Network) reservation system has linked the central installation in London with the B.E.A. offices in other main cities in England, Scotland, and Northern Ireland as well as with London Airport and other points in the London area. Soon it is hoped to extend the system to Paris, Amsterdam, and Dublin, and later to other overseas locations.

In keeping with the progressive expansion the original Univac 490's have been replaced by two Univac 494 systems.

BEACON has already broken the

back of the airline's most complex problem. B.E.A. now intends to apply it to many other aspects of its operation.

The principal new real-time systems will include a passenger acceptance and load-control system at London airport. This operation will fully automate the clerical aspects of registering passengers as they report; thus a great deal of queuing will be eliminated and more efficient service will be offered.

BEACON will be applied to cargo handling as well, much as it is at present being applied to passenger

(Continued on page 158)

QANTAS AIRWAYS, the Australian international airline, are currently involved in a program which has aims broadly similar to those of the BEACON project. However, the "QANTAM" program, which was detailed in our December 1965 issue, is conditioned to the transport of fewer passengers over much greater distances.

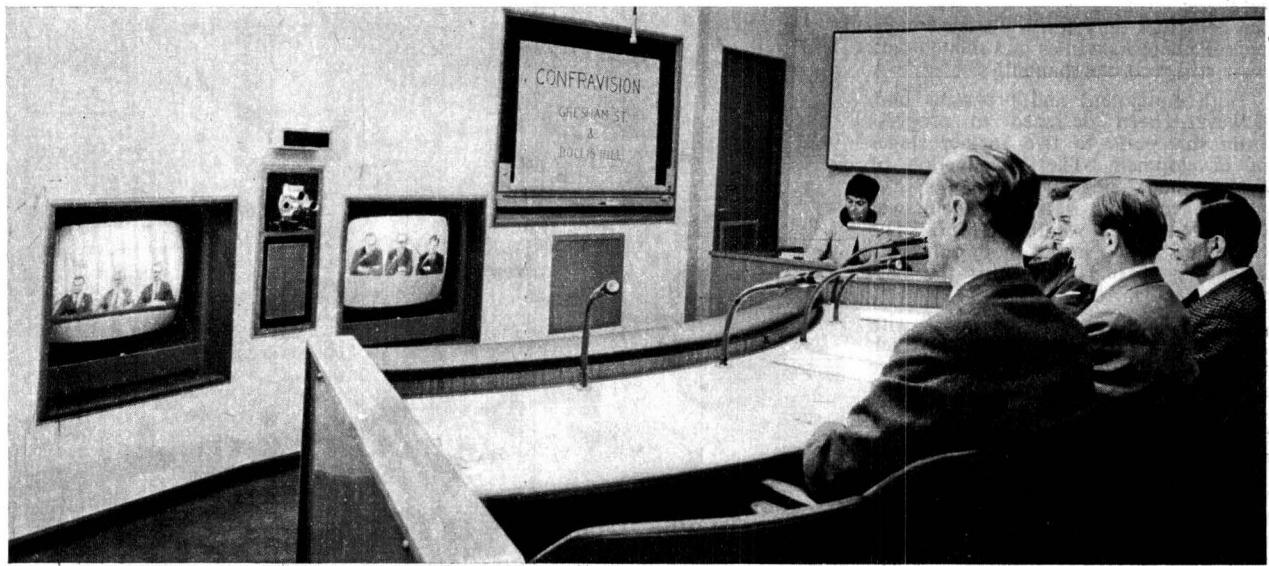
Computer equipment took over the task of message handling for Qantas in May 1967, routing messages automatically from source to destination, applying priorities in the use of circuits and throwing up for operator inspection those messages which appeared to be anomalous or in error.

The computerised Seat Reservations Control System was phased in between October 1967 and February 1968. A central computer does all the "clerical" work for recording, up-dating and analysing seat bookings but access to it still involves separate message handling by normal telecommunication facilities.

QANTAS plan to introduce progressively, and as soon as practicable, facilities for direct access to the computerised reservations system by means of enquiry sets located in remote selling offices. The enquiry sets, involving teletype keyboards, cathode-ray display, etc., as necessary, will be connected to the computer by high-speed (2,400 baud) lines. This will streamline booking procedures and make more economical use of long distance circuits.

Ultimately, the QANTAM system in Sydney will be linked across the world with BOADICEA, the computer system being set up by BOAC in London. Target date for these extended facilities is about 1972 — the year in which Jumbo jets are expected to begin flying on QANTAS routes.

Parallel expansion of computer facilities will take in passenger check-in, departure processing and other aspects of airline operation.



CONFRAVISION— an experiment in communication

A unique experiment designed to provide closed-circuit conference facilities on a time hire basis between major cities is being conducted in the U.K. by the British General Post Office.

Called "Confravision," the scheme is now being widely publicised among business houses in U.K. The G.P.O. is emphasising that the scheme is experimental and the decision whether to expand or discontinue the scheme will depend entirely on the response of the business community.

The main advantages of Confravision, says the G.P.O., are that senior company executives will not have to spend long hours travelling to and from distant centres to attend conferences with customers or colleagues; small companies will not be deprived of the top executives for many hours dealing with one client's business; sales cam-

paigns can be launched simultaneously on a nation-wide basis by one sales team operating from a central point. Other major benefits will vary according to the type of business activity of the company.

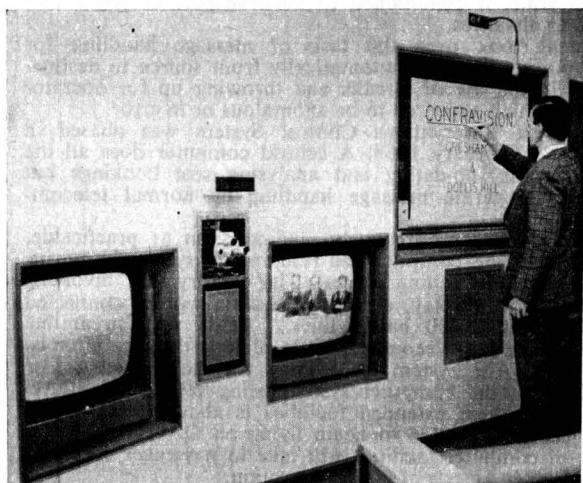
The cost of Confravision is not small—in the experimental set-up, the proposed charges are £120 (about \$258) per hour for Confravision facilities between studios not more than 100 miles apart; and £200 (\$430) for studios up to 200 miles apart. The G.P.O. points out that these costs should be equated with the expenses involved in holding conferences by other means, which would include

travelling expenses, hotel accommodation, and personal expenses. In addition, the time saving factor and reduced "wear and tear" of executives has to be taken into account.

To try to assess the likely demand for such a scheme, the Post Office has already set up experimental studios in the London area. Representatives of commercial and industrial undertakings have been invited to demonstrations of the Confravision facilities, so that they can determine whether they are likely to be able to use Confravision in the future. Should the reaction be favourable, the Post Office anticipates that they could have a fully operating public service by 1970.

The experimental studios are at Gresham Street, in the heart of the City of London, and at the Post Office Research Station at Dollis Hill, in West London. Each studio has a conference camera which can be set for an image of one, three or five participants, by a three lens turret. At present, the cameras are not fitted with zoom facilities, but when the camera is set for one person, the picture is suitable for displaying and demonstrating quite small objects.

The experimental studios are equipped to handle five participants, each of whom has an individual microphone. No microphone switching is used, all microphones being on-line together during conferences. A sound tape-recorder is connected into the system, so that any part of both ends of a conference can be recorded; or pre-recorded material can be played



TOP OF PAGE:
A demonstration by the G.P.O. of a Confravision discussion, from the experimental studio at Gresham Street, London.



LEFT: Showing the recessed camera, picture monitors and "video blackboard" used for simple charts and sketches.

into the circuits for transmission to both groups. At present, there are no facilities for video recording, although there appears to be no reason why such facilities could not be provided if specially required.

Simple diagrams, charts and drawings can be sketched on a screen of translucent material with a felt point pen, and displayed on the monitor at the other end of the conference. The user writes directly on to the translucent material, and to avoid obstruction of the picture the viewing camera is situated behind the translucent screen. The mirror image the camera sees can be corrected electronically.

For more elaborate diagrams and drawings, the studios are equipped with facsimile equipment. A document received on this can be photo-copied for distribution to the other panel of participants. Thus copies of the documents involved can be in the hands of all parties within minutes.

Within the studio, but not within the viewing area of the camera, is a fully equipped secretarial console where minutes can be taken. The person acting in the secretarial capacity has full access to the facsimile transmission and photocopying facilities. A thoughtful touch, which will certainly be appreciated by those taking part in conferences, is the provision of a studio anteroom fitted with an illuminated mirror, to allow participants to check their personal appearance before each session.

Anticipating that some people may feel nervous in the atmosphere of a television studio, the designers have gone to some trouble to eliminate the inhibiting factors of appearing "on television." The camera is unobtrusive, being set into a wall with only the lens carrier on view through an aperture. To either side of the lenses are two flush mounted monitors, one of which displays the picture from the camera in the same studio, the other the view from the distant camera.

The vision, sound and recording facilities can be under the control of the chairman or any other nominated person. All controls are contained in a simple switch box, which can be operated from the participants' position, or from the secretarial position. A switch is provided which allows sound to be cut off, for private discussion. Careful attention has been paid to acoustics and lighting, and the studios are air-conditioned.

This then, is Confravision, as presently envisaged by the G.P.O., but they regard the present set-up as purely experimental, and changes may be required in the light of operational experience. For example, there is the possibility that some large companies may find it desirable to set up their own studio, and in such a case, the G.P.O. consultation service would probably be available to assist, and to advise on standards.

If Confravision appears to be feasible economically, the G.P.O. expects to set up the first links between two or three large cities in the U.K. before the end of 1970.

The G.P.O. points out that there is no reason why the service should not be extended to smaller towns eventually should there be sufficient demand, or even to Europe and the U.S.A. ■

Widespread use of education TV in U.K.

The use of closed circuit television for education in the U.K. is now widespread, and ranges from single-channel systems in schools and hospitals to a major complex covering schools in a large part of the London area. This selection of pictures shows some of the more recent installations in action.

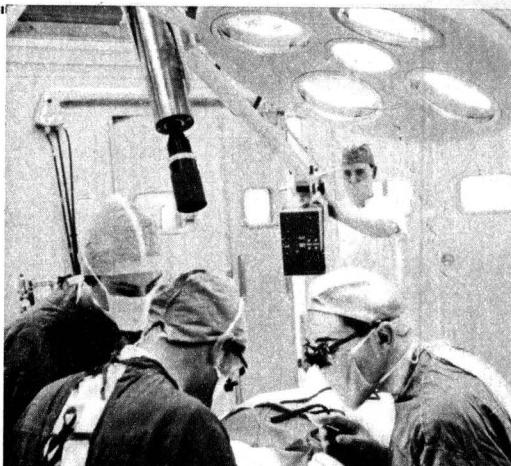
FIRST PICTURE: Moorefields Eye Hospital, London, one of the world's leading centres of eye surgery, has equipped a new four-theatre hospital suite with closed-circuit television to provide more effective training facilities for student surgeons. In this picture, the cylindrical type camera used is seen to the left of the operating light. Pictures obtained are displayed in the viewing gallery and lecture rooms.

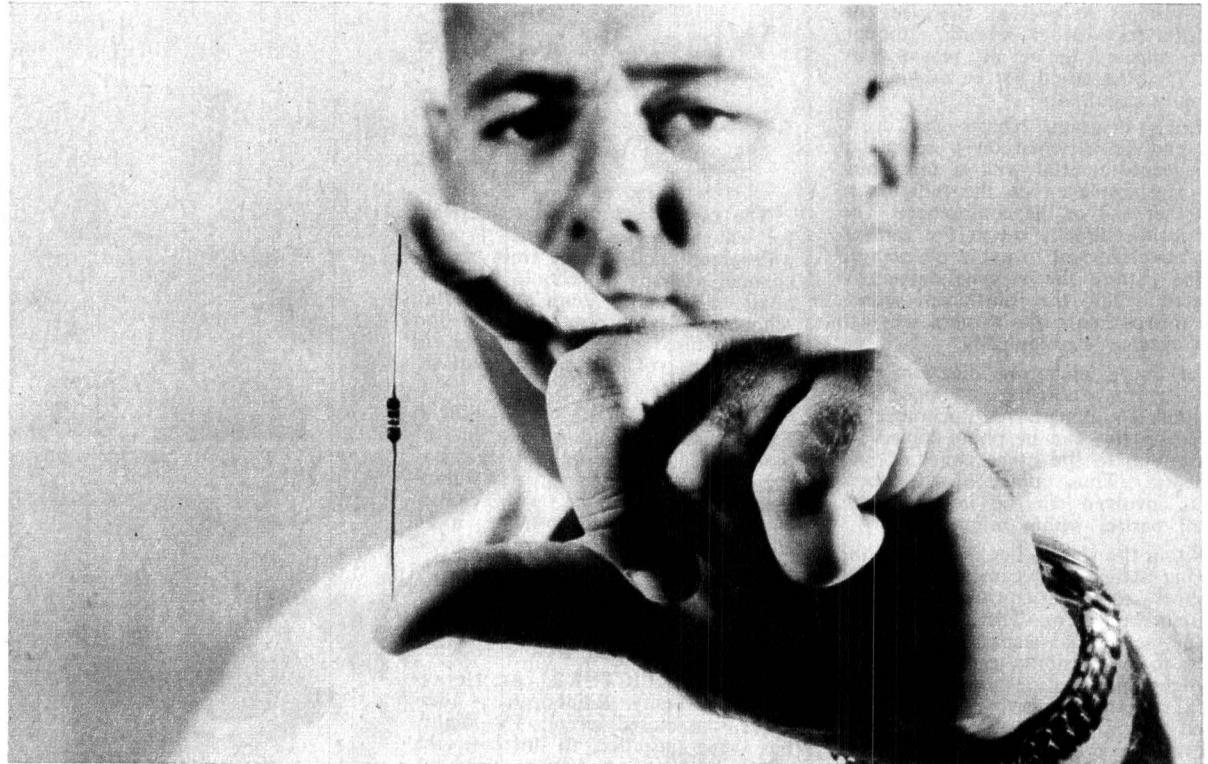
SECOND PICTURE: At Heriot-Watt University, Edinburgh, a comprehensive closed circuit TV facility has been installed to increase the effectiveness of university teaching. This occupies a complete suite of rooms, and is designed on the same lines as broadcasting TV studios. The picture shows the comprehensive vision and sound control consoles and array of picture monitors, with the studio in the background. Colour TV has been allowed for as a future requirement and all facilities have been designed with this in mind. In particular, the lighting system is capable of providing fully colour TV lighting and the air-conditioning system is designed to handle the increased heat from such lighting.

THIRD PICTURE: Now coming into use in increasing numbers for educational use are mobile television studios. Built into a 30 cwt. van, these are virtually a complete TV broadcasting and recording studio on wheels. In this picture, a camera from one of these units is seen televising work being carried out in the handicrafts room of a school, using a camera fitted with zoom lens. The unit can make a recording of an educational program for later transmission, or can relay a lesson from one classroom to a whole school.

FOURTH PICTURE: The city-wide closed-circuit TV system in London has called for special training methods for teachers who will take part in the scheme. Education authorities are running courses in television techniques which instruct teachers in writing and preparing the type of educational programs they will present on the system. Some 300 schools are due to be connected to the scheme this year, and this will be increased to around 1,300 by September, 1969.

All the television equipment for the four schemes described above was supplied by the Marconi Company, one of several companies who are major suppliers of closed-circuit television equipment in U.K.





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Laser Detects Minute Particles in Liquids and Air

A highly sensitive method of determining extremely small concentrations of solid particles suspended in liquids has been developed in the U.S.A. by the National Bureau of Standards. It operates on the principle of light scatter from a beam generated by a laser.

The method is expected to be useful in such fields as water and air pollution, medical and bacteriological research, particle-free lubrication, and manufacturing process control in micro-miniaturisation. The method was described in a paper by D. H. Freeman and E. C. Kuehner of the N.B.S. Institute of Materials Research, presented on February 2, 1968, before the New York Academy of Sciences, at a conference on liquid-borne particle metrology.

While the laser scattering technique is applicable to a number of fields, it was devised primarily to solve problems that have arisen in analytical chemistry. In the past several years, analytical chemical measurements have become sensitive to the effects of extremely small quantities of chemical contamination. One of the more difficult problems has been the presence in liquids of solid particles that are not large enough to be removed by conventional filters and whose concentration is below the level of detection by the usual methods of measurement. Typically the size of the suspended particle is less than a thousandth of a centimetre. Elaborate and cumbersome apparatus and techniques have been required to detect such particles in the small concentrations that are often troublesome. The N.B.S. scientists therefore set out to build an apparatus for this purpose that would not require much time for operation and maintenance.

The use of a laser for particle contamination measurement is based

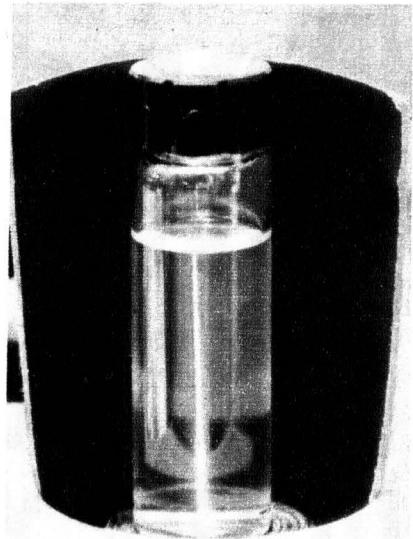
upon the fact that such small particles are a thousand million times more effective in scattering light than are the liquids in which they are suspended. The laser has the important advantage of providing a very highly concentrated beam of light, making feasible the use of small sample volumes and a relatively simple detection device such as a photomultiplier.

The apparatus uses an optical train to pass a beam from a continuous-wave helium-neon laser through the central axis of a glass tube holding the liquid sample. A photomultiplier tube placed to one side of the sample tube measures light scattered perpendicularly away from the beam path. A concave mirror on the opposite side of the sample tube is used to help return back-scattered light toward the photomultiplier detector.

To calibrate the apparatus a series of standard solutions was prepared in which the weight concentration of suspended particles was known. From the measured light scattering of the solutions of known concentration, it was possible to estimate the corresponding particle concentration in various samples.

The method was found to be so sensitive that concentrations corresponding to the ultimate limit of light scattering were readily obtained. For practical purposes this concentration is a few hundred particles per millilitre, or one part by weight of particles to one thousand million parts by weight of the liquid.

Apparatus used by N.B.S. to detect particle contamination in liquids, using a laser beam. Inside the box, the photo-multiplier detector and parabolic mirror are at left. The laser source can be seen at right, behind the box. The bright vertical line between the mirror and detector is the laser beam, scattered by suspended particles in the test solution.

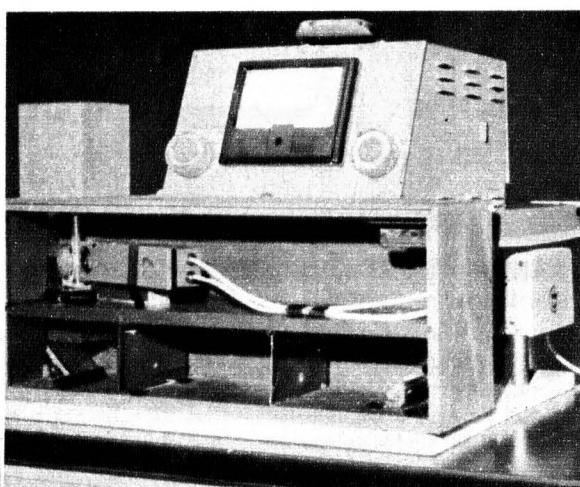


A low power laser illuminates traces of dust in a chemical reagent. The amount of light scattering indicates the contamination level of the liquid.

The results of a survey of various liquids demonstrated that the method is broadly suited to the study of particulate contamination. For example, it readily distinguishes between the particle concentrations by weight in distilled water (0.000,000,1 per cent), in drinking water (0.000,002,0 per cent), and in river water or tidal estuary water (0.000,01 per cent). Microfilters are available for removing trace quantities of particles, although no simple test of their efficacy has been made. In the present study it was found that such filters tend to be contaminated and that they are not effective until this contamination is removed.

After a routine procedure had been developed for these measurements it was possible to show that the laser technique has application to problems in a wide variety of areas. For example, although it provides no direct way of determining particulate contamination in solid materials, the solids may be dissolved in suitable liquids and the concentration of undissolved particles then measured. In a number of instances the contamination of such chemicals was found large enough for serious concern. The simple error of leaving an open vessel exposed to laboratory air was found to cause a significant increase in particle contamination.

The observed fallout of particles from the laboratory air suggested the use of the method to measure the concentration of atmospheric dust. Measured volumes of air were slowly bubbled through a liquid so that all the atmospheric dust was trapped. This made possible a measurement of the amount of dust per unit mass of air, and that sample of the air was found to be five times as contaminated with dust as ordinary tap water. This measurement suggests the desirability of directly measuring the residual air pollution in atmospheres that have already been carefully screened to remove the suspended particle contamination. ■



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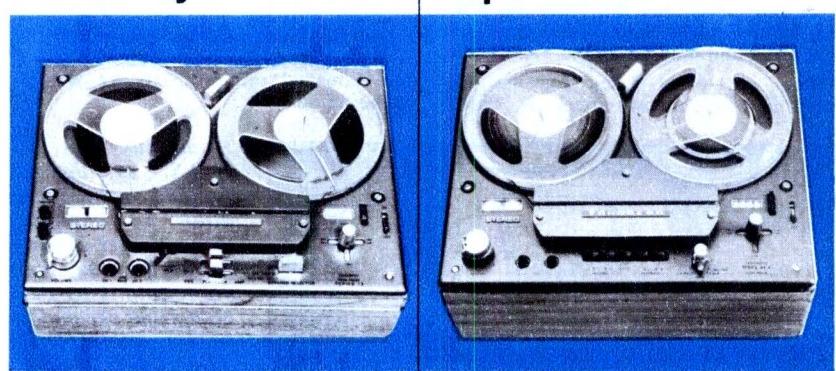
The most popular Tandberg recorders would be the Series 12 and the Model 6-4X. The former can be the heart of a high quality stereo system and features twin 10-watt stereo amplifiers; the 6-4X has been designed with the perfectionist in mind. Both recorders are a tribute to the Tandberg organization.

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WORLD WEATHER WATCH PLAN

using satellites and computers

by Louis F. Slee

Since the first TIROS weather satellite was launched in 1960, a succession of improved versions of Tiros have been launched at regular intervals. Latest developments in this field are the handling of weather data obtained from satellites by computer, and plans for a World Weather Watch network based on the three World Meteorological Centres located in U.S.A. (Washington), Russia (Moscow) and Australia (Melbourne).

Currently, during a 24-hour period, 100,000 observations of surface weather conditions are made, 11,000 upper-air observations are recorded from balloons, and more than 200 cloud-cover pictures of the entire earth are taken by satellites from outside the atmosphere. This collection of data is performed at some 8,000 land stations in every country, from 4,000 ships at sea, and by five ESSA weather satellites circling 800 miles above the earth. Yet, for all this activity, only 20 per cent of the world's weather is adequately observed for the purpose of forecasting, according to meteorologists.

Stirring in a gigantic "pot" of some 4,000 million cubic miles, weather is such a dynamic "brew" that even 100,000-plus reports a day cannot keep up with its oscillations and variations. Scientist and farmer alike are challenged to determine where its changing face will turn up next, when it will arrive, and in what form it will appear.

Now, with such modern aids as the weather satellite and the computer, with highly developed analytical techniques, and with better organised and more extensive reporting systems, the meteorologist is gaining a better grasp of the dynamics of weather. He has embarked on a World Weather Program whose objective is an accurate long-range forecast. Eventually he hopes to exercise some control over the weather and thus bring enormous economic and social benefit to a rapidly expanding world population.

The most important task of meteorologists is to prepare a forecast of the weather and interpret its potential impact on the daily activities of mankind. To do this routinely and with precision, they need information on all the weather elements — clouds, precipitation, temperature, humidity, wind, pressure and visibility—from all over the world. This must be obtained quickly for weather data are highly perishable.

The international exchange of weather information is handled through a global meteorological communications network. In the northern hemisphere, there are weather data relay centres in New York, Tokyo, Moscow, Dehli, and Offenbach, Germany, connected by radio circuits.

Within the United States, some 25,000 observations are made each day of both surface and upper-air conditions at 1,000 stations throughout the country. All of these data flow over teletype circuits into the National Meteorological Centre (N.M.C.) at Suitland, Md., just outside Washington, D.C. Some 200 pictures from the ESSA satellites are transmitted each day to the National Environmental Satellite Centre (N.E.S.C.) at Suitland via microwave link from ground stations in Alaska and Virginia. Some of these pictures come directly from ESSA satellites as they pass over the N.E.S.C. facility.

Both centres are part of the Department of Commerce Environmental Science Services Administration (ESSA). In addition, the Suitland facilities serve as one of three World Meteorological Centres, in the United States (Washington, D.C.), Australia (Melbourne) and Russia (Moscow), designated by the U.N. World Meterological Organisation.

Scientists at Suitland are developing some novel and remarkable computer techniques for improved weather forecasting. At N.E.S.C., for example, they have applied skills in mathematics, meteorology, and photogrammetry to develop a computer program for automatically processing ESSA 3 satellite cloud pictures. ESSA 3, with a pair of Advanced Vidicon Camera Systems (A.V.C.S.), delivers

150 TV pictures of the earth every day to N.E.S.C. computers. Converted to digital format, they are processed to produce a rectified photo mosaic of the northern and southern hemispheres and a region around the equator compatible with the 1-to-20-million scale maps of the world used at N.E.S.C.

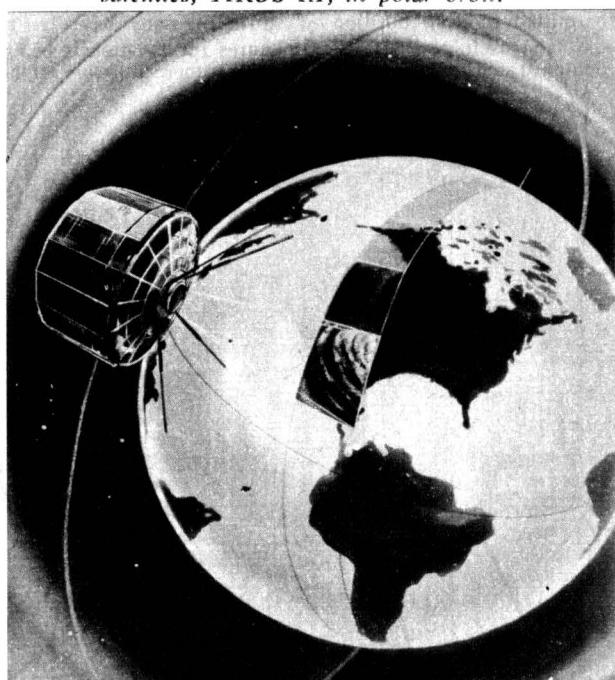
This daily computer output depicts cloud data covering 200 million square miles, the total surface area of the earth. The mosaic of northern hemisphere pictures is transmitted in facsimile format to weather stations throughout the United States. This provides forecasters with a look at global weather patterns for a consideration in long-range forecasting.

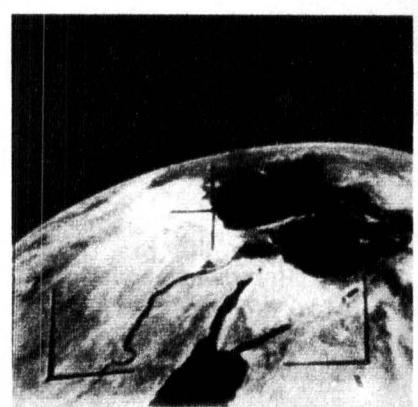
In addition to the computer display, analysts at N.E.S.C. produce a global nephanalysis based on ESSA 3 pictures. (A nephanalysis is a graphic representation of clouds.) The analysis group receives pole-to-pole strips of A.V.C.S. pictures gridded with latitude and longitude lines. Each strip is a view of weather from the satellite's most recent orbit. Using the information from these strips, the analysts prepare a nephanalysis of the northern hemisphere, adding it to some information from conventional weather analyses obtained from N.M.C. It is then sent to forecasters via teletype and facsimile circuits.

Pictures from the ESSA 4 satellite, equipped with Automatic Picture Transmission (A.P.T.) cameras, also are received and processed at N.E.S.C. A.P.T. pictures can be received anywhere in the world with simple ground receiving equipment as ESSA 4 orbits overhead. The unique, RCA-built A.P.T. camera provides meteorologists with a weather picture covering 4 million square miles a few minutes after the picture is taken.

Some 45 nations are receiving instant weather pictures

Artist's impression of one of the latest weather satellites, TIROS IX, in polar orbit.





directly from ESSA 4. In addition to foreign national weather services, universities in many countries and a host of television stations in the United States, such as the N.B.C. affiliate WSM-TV in Nashville, Tenn., are receiving A.P.T. weather pictures. The Free University of Berlin publishes a daily mosaic weather map of A.P.T. pictures it receives. The French weather service distributes a similar A.P.T. weather map, and the French Government has installed an A.P.T. station at Tahiti in the South Pacific. In Kenya, the meteorological service built its own receiving equipment, using a ship's mast and scrap copper tubing for an antenna and adapted a facsimile recorder to be compatible with A.P.T. picture transmission.

In many parts of the world, weather observation networks are partly or completely inadequate. Even areas with adequate networks still have the problem of obtaining observations of weather conditions over sea areas upstream in the weather pattern. Detecting a tropical storm in advance of its approach to land is difficult without satellite observations.

The enthusiasm with which meteorologists welcomed A.P.T. pictures and the international goodwill expressed toward the United States for its policy of making the pictures available to all on an equal basis were reflected in many cables and letters received at N.E.S.C. when ESSA 2, the first A.P.T. satellite, was orbited in 1966.

Australian meteorologists cabled: "Local advisory bulletin of tropical cyclone at 15 south, 118 east issued on basis A.P.T. picture 30 March, although no supporting evidence at this time from other sources. A.P.T. proving of great value Australian region."

From Tananarive, Madagascar, came this message: "On first pictures acquired, A.P.T. equipment recorded presence of strong tropical disturbance in Indian Ocean. This disturbance was suspected but not located and data from A.P.T. pictures caused great excitement in local meteorological service. A.P.T. equipment has followed and permitted plotting position of storm on daily basis."

The usefulness of A.P.T. pictures for aviation is being demonstrated every day at the Weather Bureau High-

Typical pictures of earth weather conditions obtained from TIROS satellites.

LEFT TO RIGHT:

The British Isles, with the whole of England, Wales and Scotland blanketed by cloud, while Ireland basks in the sun.

A large vortex of a typhoon near New Zealand.

A sunny day in the Near East; visible are Libya, the Nile River and its delta, the Suez Canal, the Red Sea, Israel, Arabia and the Mediterranean.

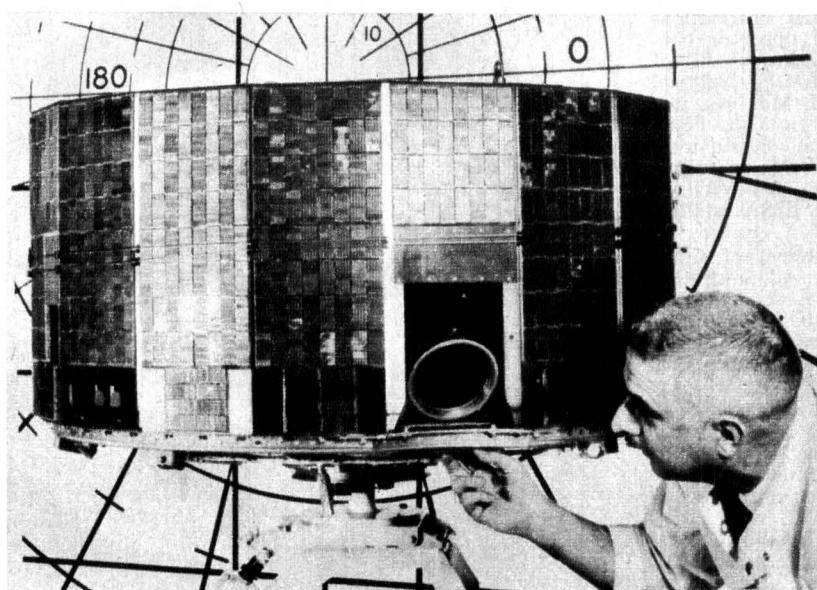
Level Flight Forecast Centre at Kennedy International Airport in New York. There, satellite pictures are used daily in the preparation of operational aviation forecasts for flights bound for Europe, Africa and the Caribbean.

A special base map compatible with A.P.T. pictures is prepared by the centre's cartographer. Pictures received at the centre are superimposed on the map along with pilots reports and forecasts of winds, icing, and turbulence for each of the three destination routes. This becomes a master which is photographed to produce copies of three separate route sections for distribution to departing pilots. A.P.T. weather maps afford pilots a more comprehensive picture of in-flight weather. The centre at Kennedy also is experimenting with the computer mosaics of A.V.C.S. northern hemisphere photos, relayed from Suitland, to supplement the A.P.T. air route weather maps.

While satellites keep watch on the atmosphere from above, ground-based observers below send instruments aloft aboard balloons to radio back weather data such as pressure, temperature, and humidity, measured at specific altitudes. With thousands of these and other observations pouring into N.M.C. every hour, the centre operates on a three-shift, 24-hour schedule, seven days a week. It requires rooms filled with communications and computer equipment to handle the data, and the equipment is manned by specialists who work at an intense pace to meet established deadlines.

The surface and upper-air observations from around the nation are fed to a pair of computers at N.M.C. which read, identify, evaluate, and analyse the information. Part of the output goes to a third computer for numerical forecasting of upper-air and surface conditions. These forecasts range from six hours to six days.

The computer has been responsible for the greatest advance in weather forecasting in the past 10 years, according to David J. Stowell, staff assistant to the N.M.C. director. In another of its uses, the computer has been programmed to simulate the equivalent of air at ground level being



One of the latest TIROS satellites undergoing tests before delivery to the launching site. The calibration chart visible in the background is used to check lens distortion and angular coverage of the two tin vidicon cameras carried by the satellite.

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Separate speaker systems are essential if you wish to exploit the full potential of your amplifier, tape recorder or radio. Sonics speaker systems are beautifully finished in selected walnut/teak veneers, are styled to blend with period or modern decor and are extremely effective from an audio point of view. The following five models are the most popular.

MODEL AS-57. A compact 2 speaker system only 15½" x 8½" x 5¾". Ideal for use as a bookshelf enclosure. Impedance is 8 ohms. Separate bass/mid-range speaker and tweeter. Inc. sales tax. **\$22.50**

MODEL AS-65 Bookshelf type—Measuring 16½ in. x 9½ in. x 8½ in., this enclosure is compact and most effective. The speaker unit is a twin cone, wide range loud-speaker **\$24.50**

MODEL AS-60E Slim Line 2 Speaker System—Although only 16 in. x 12 in. x 5½ in. the AS-60E houses a bass/mid-range speaker and a high frequency reproducer. Impedance: 8 ohms **\$27.50**

MODEL AS-61 5 Speaker Slim Line System—Four bass/mid-range speakers and 2½" tweeter unit are housed in this attractive teak/walnut enclosure. Impedance: 8 ohms. Measures 21½ in. x 17½ in. x 4½ in. **\$38.50**

MODEL AS-80 2 Speaker System—With an 8" high compliance bass reproducer and a 2½" tweeter unit, the AS-80 is a favourite with owners of stereo systems. Measures 22½ in. x 13 in. x 6½ in. and handles 25 watts of music power **\$38.50**

MODEL AS-202 3 Speaker System—This dramatically effective 3 way system measures 20½ in. x 11½ in. x 11½ in. and features an 8" bass speaker, a 6½ in. mid-range reproducer with a sealed back with a 2½" tweeter. Power handling capacity is 20 watts music power **\$44.50**

IMPORTANT: All Sonics enclosures have 8 ohm impedances. Sales tax is included in all Enel prices.

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Included in the wide range of stereo tape decks at Enel Stereo Centres you will find the Akai 3000D and X150D, the Revox G-36, the Tandberg Model 64X, National decks and also models from Toshiba. Ask for an EMQ or a trade-in valuation.

THE NEW ORTOFON S-15 AND SL-15 STEREO CARTRIDGES AVAILABLE AT ALL ENCEL STEREO CENTRES!

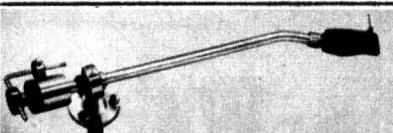
World wide acclaim provides significant testimony to the outstanding performance of the new Ortofon S-15 and SL-15 series. Ask for an EMQ or a trade-in valuation.

NEW SOUND MODEL SAQ-203 SOLID STATE MAG. SENS. STEREO AMPLIFIER ONLY \$69.50!

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Two models of this sophisticated arm are available . . . the 12" G-540L and the 14" G-560L. A gimbal type gyroscopic bearing is used — and the Grace arm will track suitable cartridges down to ¼ gram with ease. A super light-weight head shell is supplied. Since this arm became available at Enel Stereo Centres many fastidious enthusiasts have traded much more expensive arms of Continental origin. Enel prices Inc. sales tax . . . G-540L **\$34.50**

FROM CONNOISSEUR . . . THE NEW AND HIGHLY SUCCESSFUL SAU-2 TONE ARM! With a revolutionary type of gimbal mounting with axis at 45°, the SAU-2 tone arm is both unusual and remarkably effective. Bias adjustment is automatic — playing weight is controlled by a rear counterweight with a resilient backing to dampen the action. A lifting/lowering device is standard equipment — and the head-shell accepts all standard ½ in. mounting cartridges. A small set of scales are provided to set stylus pressure — they are accurate to 0.1 gram. Height of the arm is adjustable from ¾ in. to 1½ in. This new Connoisseur arm will track down to ½ gram. Read the review of the SAU-2 tone arm and the Connoisseur Classic turntable in "Hi-Fi News", May, 1967, p. 133-5. Write for copies. Enel price (including Sales Tax) is only **\$24.50**

If you trade-in an All Balance arm, with lift you pay only \$12.

MICRO MA-88 PROFESSIONAL 16 IN. TONE ARM

Designed to provide effortless tracking with the most delicate cartridges, the MA-88 accepts S.M.E. and ORTOFON head shells as well as the MICRO head shell. The latter may be used with any standard ½ in. mounting cartridge and cartridge location is adjustable by a fore and aft movement of approx. ½ in. Vertical and lateral movement is almost friction-free and is estimated at less than 20 milligrams. Height is adjustable and a bias scale and bias hook system eradicates lateral pressure of the stylus. Stylus tracking pressure is adjustable from 0.5 grams and is clearly indicated on the outrigger scale. Enel price including Sales Tax **\$35.50**

MICRO-MA-77 and MA-77 TONE ARMS

Very similar in construction to the MA-88, these tone arms are 12 in. and 14 in. long respectively. A unique eccentric counter balance weight is employed with the "77" series. Connections of all MICRO arms are plug-in types to eliminate soldering, general construction is of machined solid brass and finish is satin chrome. All MICRO arms pivot on miniature ball races. Both these models incorporate the bias hook and weight system to eradicate lateral pressure. Enel price Inc. Sales Tax **\$29.50**

LIFT NOW AVAILABLE FOR MICRO ARMS A tailored lifting/lowering device is now available for all Micro arms. Easily fitted, pneumatically dampened action **\$8.50**

READ THE REVIEWS!

Your April, 1966, copy of "Electronics Australia" contains a review of the MICRO MA-77 tone arm on pages 128-127. If you subscribe to "Hi-Fi News" look up your February, 1966, copy for an extensive review of the MICRO MA-77 tone arm and the M-2000/5 magnetic cartridge. This particular review extends over 4 pages. Write now for copies!

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Several wide range stereo headsets are in stock — and prices are as low as \$9.50 for one high quality "Sonics" headset. The popular "Sonics" Model HS-304 is very comfortable and response is excellent. Cost is only \$12.50. From P.M.L. in Sweden comes the "Pearl" headset . . . a particularly sensitive high impedance (400 ohms) type. This model is fitted with ear muffs for maximum comfort during lengthy periods of listening. Price is \$19.50. All Enel prices include sales tax. **\$9.50**

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Micro have now released the Models 3100/5 and 3100/E (with elliptical diamond stylus). Prices are \$24.50 and \$29.50 respectively Inc. sales tax. Both cartridges have an extended frequency response and performance is outstanding. Write or call for additional information.

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A complete range of world famous Wharfedale sound reproducers is always available at Enel Stereo Centres . . . write or call for an EMQ or a trade-in valuation. Models include Super 3, Super 5, Super 8, Super 10 RS/DD, Super 12 RS/DD, W12/FRS, W15/RS, PST/4, 8" Bronze RS/DD, 10" Bronze RS/DD, Golden 10 RS/DD and the 12RS/DD. Complete enclosures available include the "Denton" and the "Super Linton".

CONNOISSEUR STEREO CARTRIDGE MODEL SCU-1

Regarded as the finest ceramic stereo cartridge produced anywhere in the world, the SCU-1 will load any normal amplifier or tape recorder. Tip mass is 1 milligram, vertical compliance 8×10^{-11} cm/dyne, lateral compliance 12×10^{-11} cm/dyne. Audio quality is exceptional and includes a pleasant musical transparency. Ask for copies of reviews. Enel price including Sales Tax **\$10.80**

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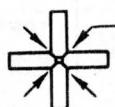
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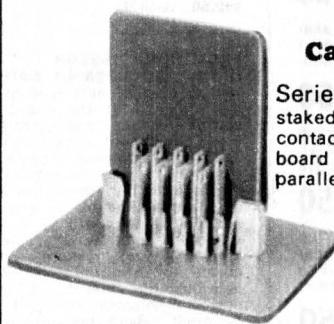
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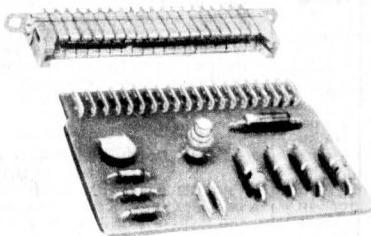


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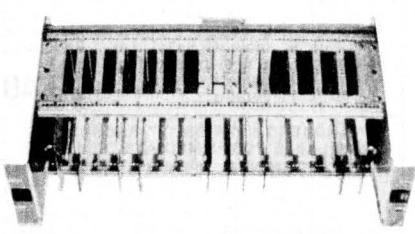
Printed Circuit Connector

Series 5002, 5004 VARICON* Connector.



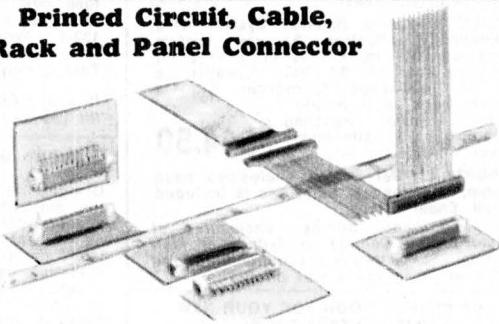
The most versatile of all printed circuit connectors, the Series 5002 conforms to the 0.1" grid pattern having contacts at 0.200" centres. Being of modular construction a variety of sizes is available with 2-44 contacts for card thickness of $\frac{1}{16}$ " and $\frac{3}{32}$ ". Polarisation is achieved without loss of contacts.

Printed Circuit Card Packaging



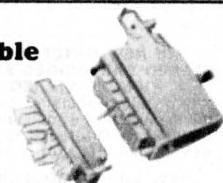
The VARIPAK* II Card Enclosure is the modern economical all-aluminium concept, designed for adaptation to almost any printed circuit card arrangement. It provides maximum density and holds cards and connectors in the correct alignment.

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Series 00-8129 Subminiature VARICON* Connector employs a one piece diallyl phthalate insulator, with 6, 9, 12 or 15 subminiature VARICON* contacts in single row on 0.1" centres.

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Series 00-8016 — Miniature VARICON*

connector employs VARILOK* crimp type contacts in both plug and receptacle. The Series 00-8016, 8017 and 8018 miniature VARICON* cable connectors are available in sizes up to 140 contacts. Optional features include actuating screw, top or side cable entrance and polarisation.

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lifted to 18,000 feet. The computer compares the relative temperature of the parcel of air raised from the ground with the surrounding air at high altitude to see whether the raised parcel of air will rise or sink back in the simulation. If it rises, the computer output chart will show the rise—an indication of an unstable condition in the region where the ground air sample was taken. To the forecaster, this means a probable occurrence of thunderstorms. This is accomplished by feeding measurements of the air at different altitudes to the computer which is programmed with a thermodynamic model of the atmosphere. The output data, called a lifted index measurement, then is sent from Suitland to the Severe Storms Forecast Centre.

Another job done by this computer is to predict rain by forecasting the three-dimensional motion of the atmosphere, combined with measurements of atmospheric moisture content. When the model indicates moisture saturation of the air at a given time and place, it simulates clouds and precipitation. At that point, "numerical rain" will "fall out" of the computer on a precipitation chart.

ESSA is working on improvements in data processing as well as data distribution. Currently, the quantity of weather information available to the Suitland computers exceeds their capacity. Looking toward the future, ESSA scientists anticipate better ground display equipment for satellite pictures, automatic plotting, equipment, higher resolution satellite television cameras, and synchronous weather satellites as well as better computers.

All of these technological improvements are required to implement the concept of a new World Weather Program.

The World Weather Program has two major goals for the period 1968 to 1971. One is the development and operation of a World Weather Watch, an idea of the World Meteorological Organisation (W.M.O.). Through a plan presented at the W.M.O. Congress at Geneva in 1967, the new tools of meteorology—satellites, computers, automatic weather stations, and the global communications network—will be linked together through international co-operation to observe and report on the earth's atmosphere as a whole. This will update and modernise the present world weather system for improved forecasting and permit a global meteorological experiment to compile comprehensive atmospheric data on a scale never before possible.

The second goal is a great research program leading to accurate simulation of the physical processes of the atmosphere for long-range forecasting and a theoretical study of weather modification. Biggest obstacle here is the lack of global observation data. Thus, the achievement of the first goal will be important to the implementation of the second and an understanding of the forces that create weather.

Initial steps in the program call for distribution of weather data among the three World Meteorological Centres (Washington, Moscow, and Melbourne) and national weather services around the world. A number of regional

Electronics enhance "Orbiter" photos

At the National Aeronautics and Space Administration's Langley Research Centre, Hampton, Virginia, a group of Boeing engineers is turning out improved photographs of the moon taken by the five Boeing-built Lunar Orbiters. Called "photo enhancement," the task is being done under contract to the Langley Research Centre, which managed the Lunar Orbiter program. The purpose: to squeeze more information out of the Orbiter photos for study by space scientists and engineers.

Tape recorders and "ground reconstruction electronics" (G.R.E.) equipment are being used by the photo enhancement group to reprocess video tapes received during five lunar missions. The tapes contain essentially all the photographic information transmitted to Earth from the Orbiters' cameras. Uncovering the previously hidden data on the video tapes was a slow process at first, involving several passes of each section of tape through the equipment. To speed things up the Boeing team developed the "Mini-Kludge."

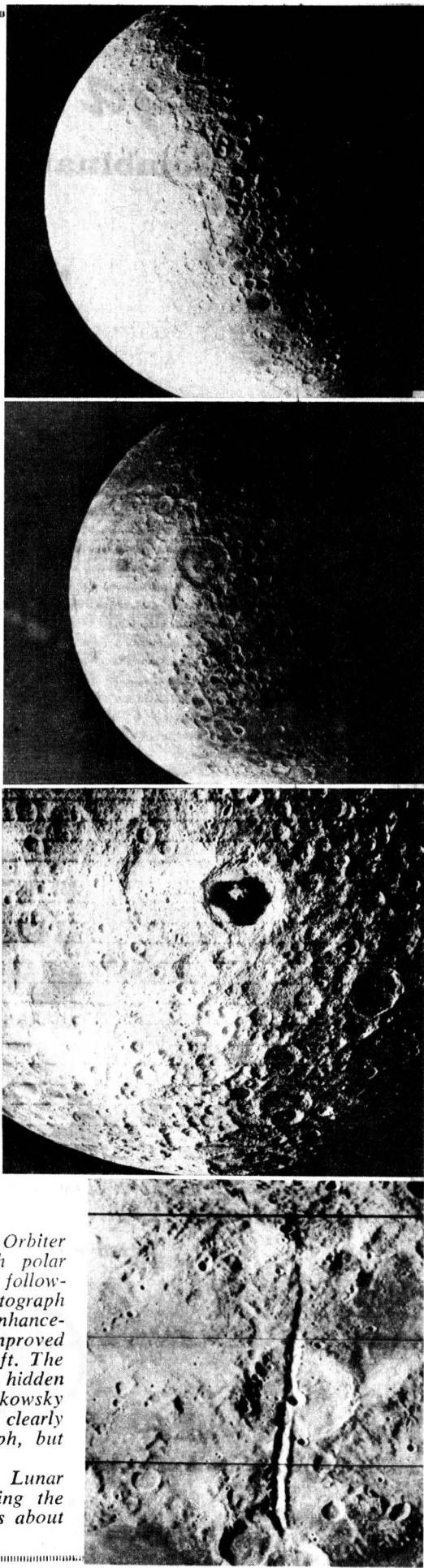
"Kludge" is an all-purpose, data-processing noun, believed to have been coined at Boeing about 10 years ago. The word has a variety of meanings, among them, "a device too complicated to explain and you wouldn't believe it anyway," and is pronounced "Kloo-j". Mini-Kludge is a small Kludge.

In this case, it is a video processor which examines details in selected portions of the video signal. Data within the signal may be expanded to give better resolution and contrast and therefore a sharper photograph.

The signals from the video tapes are fed through one of four G.R.E. units used at the N.A.S.A. centre. The Mini-Kludge adjusts the signal level to bring out more detail in light areas and hold or improve resolution in the dark areas. The photo-improvement job should be complete later this year. More than 14 million square miles of cratered surface were captured on about 700 miles of video tape.

Analysis of Lunar Orbiter photographs will keep scientists and engineers busy for the indefinite future. Mini-K will help give the researchers a few extra years of study.

The top picture shows a lunar Orbiter photograph of the moon's south polar region before enhancement. This is followed by a picture of the same photograph after it has been treated by the enhancement method. Note the greatly improved detail in the light areas on the left. The third picture shows part of the hidden side of the moon, with the Tsiolkowsky Crater prominent. This crater is clearly visible in the enhanced photograph, but is not visible in the top picture. BOTTOM: Part of one of the Lunar Orbiter composite pictures, showing the fine detail obtained. The trough is about 150 miles long.



(Continued on page 158)

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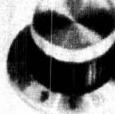
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Technical Review

RF Field Strength Meter Indicates Detonation Danger

The National Bureau of Standards in the U.S.A. has developed a special type of RF field strength meter for the Defence Atomic Support Agency (DASA) for measuring RF fields near electro-actuated explosives. The meter can measure RF field strengths from 0.1 to 1000 V per metre. Although designed for the military, the meter would have equal applications in civil engineering.

The electromagnetic fields near antennas of radio transmitters can cause premature detonation of explosives; hence the admonition at construction jobs, "BLASTING — Turn Off Two-Way Radios." The much stronger fields in the immediate vicinity of powerful military radio transmitters in battle areas and aboard naval ships present a great hazard in handling and storing electro-actuated explosives. Such strong fields have been known to explode shells, damage instruments, and ignite fuel vapors, as well as to possibly cause biological harm to personnel exposed to such fields.

DASA called on NBS to design and produce a meter measuring RF fields from 0.1 to 1000V/M, a prototype of instruments that could be used at frequencies from 0.15 to 30MHz. Physical requirements were particularly exacting: the part of the instrument placed in the near field could be no more than a metre in length and had to have a diameter of less than 2in. No connecting cable could be used that would alter the field or degrade instrument performance.

The field strength meter was developed by Frank M. Greene, of the N.B.S. Radio Standards Laboratory at Boulder, Colorado, who fabricated a model covering the frequency range of 150-250-KHz and another covering 16-30MHz. The instruments can be used to measure within two feet of an antenna without unduly perturbing the measured field.

In the field-strength meter that was developed, perturbing effects on external fields were virtually eliminated by using a specially developed semiconducting plastic transmission line and by designing compact RF components and circuitry that could be enclosed within a hollow dipole measuring antenna. The dipole consists of two 1 $\frac{1}{2}$ -inch-diameter copper tubes each about 6 $\frac{1}{2}$ inches in length. These are positioned end-to-end by a central insulating sleeve.

Because of the extremely high RF line loss, all RF and calibration circuitry had to be miniaturised and placed, with its associated batteries, inside the measuring antenna.

The suitability of this design for DASA's requirements was demonstrated by two similar prototype RF instruments, one of which included the low-frequency end of the range of interest and the other the upper limit. Each dipole contains a radio receiver consisting of an input capacitive step attenuator, a fixed-tuned, band-pass, RF amplifier, and a detector providing an output in the range from 0.75 to 7.5V. Each dipole also contains a calibrating oscillator which is tunable over the passband of the receiver and can be switched via a resistive attenuator to the receiver attenuator in place of the antenna. Its unattenuated output is also detected for use in the calibration procedure.

The dipole unit is mounted in a circular polyfoam gimbal ring (transparent to electromagnetic fields), so that the dipole can be oriented to pick up the desired component of the electric field. The dipole is connected to the indicating unit by means of a 30-foot length of the specially developed semiconducting cable. The same transmission line and indicator unit are used with either RF unit to provide a meter indication of field strength and an aural beat signal from its loudspeaker, which is used in tuning the calibrating oscillator.

The special nonmetallic balanced transmission line connecting the RF unit with the indicating unit is essential to the operation of the N.B.S. near-zone field-strength meter. The material conducting the DC signal was selected to be midway (on a logarithmic scale of resistance) between a good conductor and an insulator; it has a volume resistivity of approximately 3 ohm-centimeters. It is made by adding (during manufacture) 30 per cent. (by weight) of carbon black to polytetrafluoroethylene.

A .03-inch diameter monofilament of the semiconducting material is coated with a thin layer of nylon and is in turn covered by a woven fibreglass sleeve having an outside diameter of about 0.1 inch. Two such insulated conductors are enclosed side by side in a polyvinyl chloride outer jacket to form the transmission line. The perturbation of the electromagnetic field by this line is more than two orders of magnitude below that caused by copper conductors.

The plastic conductor has a resistance of approximately 20,000 ohms per foot and the transmission line, 1.2 megohms for the 30-foot length. The input resistance of the indicating unit is high — about 200 megohms — so that less than 1 per cent. of the signal is lost in the transmission line. The line introduces some noise when flexed or moved, but the desired signal is in the 0.75- to 7.5-volt range; therefore, the slight flexural noise is not a problem.

The field-strength meter is used by mounting the dipole and gimbal on top of a tripod at the desired point in the electromagnetic field. The 30-foot transmission line emerges from the side of the gimbal and runs to the indicator unit, which is positioned further out in the field and facing the operator. Once the indicator unit is properly adjusted, the user performs all further operations at the dipole, using the visual and aural indications of the indicator.

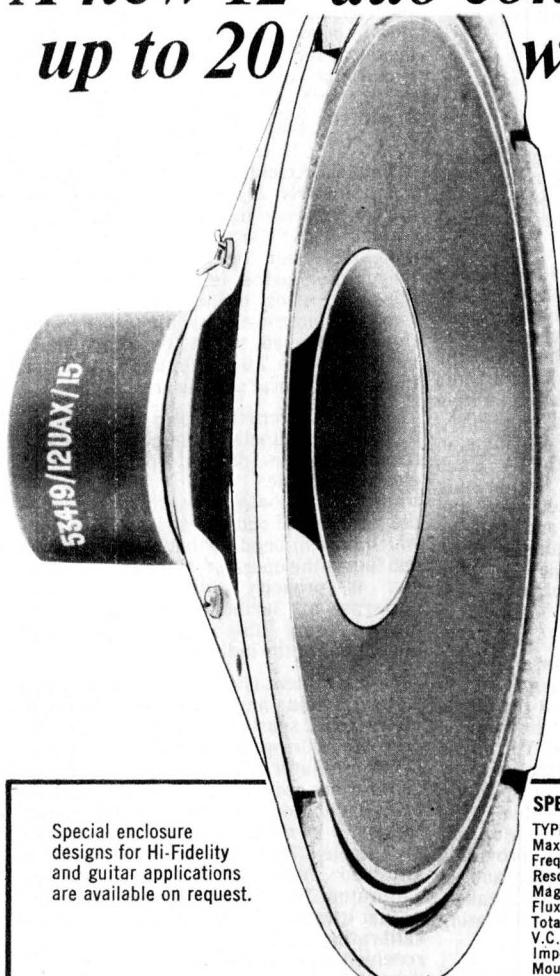
The instrument is calibrated initially in a standard field; any subsequent change in instrument sensitivity can be readily corrected during use by means of a built-in CW oscillator. This is done by tuning the calibrating oscillator, using the audible beat indication, to the desired radio-frequency by means of a knob at one end of the dipole. Then the receiver input is switched from the antenna to the calibrator. The receiver gain is adjusted so that its output is the same as that of the calibrating oscillator detector, the receiver input is returned to the dipole and the strength of the unknown signal can then be read directly from the meter.

The present uncertainty of the standard calibrating field developed for these meters is estimated to be less than \pm 2dB, and the field-strength measurements are judged to be accurate to approximately the same figure. Continuing development effort on standard fields is expected to reduce this uncertainty to less than \pm 1dB ("Technical News Bulletin," February, 1968.)

This new speaker combines rugged bass diaphragm with a coaxially radiating high-frequency flare to give excellent wide-range performance. This basic unit has been extensively tested in both high-fidelity and guitar applications and has now been matched with its own specially designed high-frequency flare resulting in an extended range of 45 to 12,000 Hz while maintaining a power rating of 20 watts (15 watts for guitar applications.) The Hi-Flux magnetic system and matched voice coil gives this unit full rich bass and extended treble performance for hi-fi, stereo or guitar applications.

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Hi-Flux SPEAKER

TYPE 12UAX

The three versions of this 12" speaker are an extended range type 53419/12UAX/15 with a frequency coverage of 45-12000 Hz and two general purpose speakers type 53348/12UA/15 and 53422/12UA/8.

SPECIFICATION

TYPE NUMBER	53419/12UAX/15	53348/12UA/15	53422/12UA/8
Maximum Power Handling	20W (15W for Guitar)	20W (15W for Guitar)	20W (15W for Guitar)
Frequency Range	45-12000 Hz	45-6000 Hz	45-6000 Hz
Resonance	50 Hz	50 Hz	50 Hz
Magnet Material	Alnico V	Alnico V	Alnico V
Flux Density	13,000 gauss	13,000 gauss	13,000 gauss
Total Flux	100,000 lines	100,000 lines	100,000 lines
V.C. Diameter	1 1/2"	1 1/2"	1 1/2"
Impedance	15 ohms	15 ohms	8 ohms
Mounting Hole Centres	11 1/2" P.C.D.	11 1/2" P.C.D.	11 1/2" P.C.D.
Maximum Depth	4 1/2"	4 1/2"	4 1/2"

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EXPERIMENTAL TUBELESS COLOUR TELEVISION RECEIVER

Because of problems associated with the shadow mask tube now used in domestic colour television sets, electronics engineers are continually exploring other approaches. In Japan, engineers of the Sony Corporation are conducting experiments designed to examine problems likely to arise should light emitting diodes be developed to the stage where light output is sufficient for this application.

As a first step, they have built a colour receiver in which the picture is presented on a matrix of light bulbs. This has resulted in a screen with an 8ft diagonal, using 78,000 miniature light bulbs, 260 SCRs, 4,000 transistors and a power supply which delivers 300A at 30V. The most important innovation in the system is the conversion of standard video signals into pulses for digitally scanning the X-Y matrix with pulse-width modulated signals.

Sony's colour video panel uses light bulbs arranged in a matrix with 260 horizontal lines of 300 lamps each. The lines are staggered to form red-green-blue colour trios spanning two lines.

A television signal is picked up by a standard receiver and the three colour signals are separated from the audio and synchronisation signals.

The colour signals are sampled to generate pulse-width modulated signals with a constant amplitude but a width proportional to the intensity of each colour signal.

For zero intensity (black), the pulses have zero width. For maximum intensity, the pulses are about 100 microseconds wide. The eye integrates the light and perceives lamps that stay on longer as being brighter than lamps on for less time.

Each output transistor in the X channels is operated at a duty cycle of 0 to 75 per cent. These transistors are operated in the PWM mode at a period of twice the horizontal-line time, with the peak currents of the lamps. For this type of operation, the dissipation of the output transistors in the various channels runs in the range of 100 to 300 milliwatts. Neither the current value nor dissipation is much of a problem; the output transistors in the X channels are operated without heat sinks.

The vertical synchronisation pulses start the display at the top. The horizontal lines are turned on, one at a time, by SCRs connected to each line. The horizontal lines stay on for twice the horizontal scan time.

The 78,000 ordinary tungsten pilot lights form 26,000 red-green-blue trios. Though this is less than 1/10 the number of elements on a conventional

colour tube, the picture resolution isn't degraded as much as one might think. In the X-Y video panel, completely independent information is injected into each light bulb. In a picture tube, the electro-beam spot is ordinarily large enough to cover three or four of the holes in the shadow mask. Furthermore, in the tube, reproduction of areas with white-peak brightness is degraded by increases in spot size, which cause the phenomenon known as blooming. However, blooming cannot occur in the colour video panel because each bulb gets information independently from its neighbours.

This keeps the picture surprisingly sharp.

Another advantage over the tube is that colours cannot be misregistered. In the tube, beams are aimed at colours and may misconverge. But in the video panel, signals are fed directly to colours and thus always stay in proper relationship.

On the other hand, the picture produced by the panel's 26,000 trios, is not as detailed as that of the picture tube, which has 350,000 elements. Interlaced scan cannot be used, because there are only 260 horizontal lines. However, non-interlaced scan can provide reception that is satisfactory even though it is not up to normal standards. Non-interlaced scan is used in the small Sony video tape recorder designed for home use.

The video signal must be sampled to convert it to the multichannel signals required to drive the colour video panel. With 300 lamps in each horizontal line, picture information from the original signal for any one lamp must be sampled within an interval



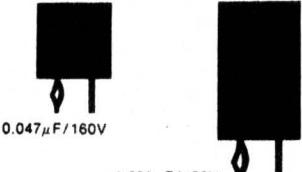
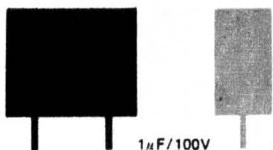
This picture of a portion of the Sony video panel clearly shows the dot structure created by the light bulbs. The panel uses incandescent lamps with filter caps for the red-green-blue trios. The panel measures about 6ft. by 5ft., giving a diagonal of about 8ft. (This picture reproduced from "Electronics", Vol. 41, No. 8.)

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 1.5 μ F/25V	MKL — PLASTIC LACQUER CAPACITORS (Metallised Cellulose Acetate) Capacity range 0.01-10 μ F Voltage range 25-250V	Extremely thin dielectric permits high capacitance per unit volume. Self healing, surge resistant and suitable for pulse sensitive circuits. Highly reliable. Also available hermetically sealed.
 0.047 μ F/160V 0.068 μ F/400V	FKH — POLYESTER CAPACITORS for printed circuits Capacity range 0.01-0.47 μ F Voltage range 160V and 400V	Of main interest is their attractive price (only a few cents), making these capacitors very suitable for commercial application, e.g. Radio and T.V.
 1 μ F/100V	MKH — METALLISED POLYESTER Capacity range 0.01-6.8 μ F Voltage range 100-630V	Compact size. Incapsulated in plastic case, epoxy sealed. Particularly suitable for printed circuits. Types with long leads also available. Can be supplied as Metallised Polycarbonate, (MKM).
 10 μ F/100V	PROFESSIONAL ELECTROLYTIC CAPACITORS Capacity range 10-1000 μ F Voltage range 6-100V	Long life and high reliability. High surge handling capacity. Very low leakage current. Designed for use in professional equipment required to operate over many years under continuous duty condition and with minimum failure rate.
 33 μ F/16V	TANTALUM "PEARL" CAPACITORS Capacity range 0.1-220 μ F Voltage range 3-35V	Miniature solid tantalum capacitors suitable for printed circuit application. Apart from use in professional equipment their price makes them also suitable for commercial applications.

Further Information available from Components Group

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SH302



SONY DEVELOP SINGLE-GUN COLOUR TUBE

As well as their interest in the matrix type screen presentation for colour TV, outlined in the previous article, the Sony Corporation is also carrying out considerable research and development work on improved forms of colour TV tube of the conventional kind. This description of a new type of colour tube appeared in recent issues of "Electronics Weekly" (May 1 and 8, 1968.)

less than 1/300 the horizontal period of 63.5μS. The sampling interval is thus 0.05 to 0.1μS.

The red lamps have a DC rating of 2V and 30mA. Green lamps have a DC rating of 1.5V and 30mA. Blue lamps have a DC rating of 1.5V and 70mA. However, the lamps are not used at their rated current and voltage levels.

The lamps are used for only a maximum duty cycle of 0.7 per cent — at 30V for 100μS maximum out of each 16.7mS. The peak current for the red lamps is 400mA, for the green lamps 600mA, and for the blue lamps 1A.

The pwm signal can be obtained with simple circuits. The amplifiers are saturating transistor switches that are either in saturation or off, so that gain doesn't vary between channels. Because amplifier output efficiency approaches 100 per cent and collector dissipation is low, there is a good chance that circuits can be integrated.

The lamp current is not constant while the pulse is applied. Lamp voltage, as noted, is constant. The lamp current varies during the 10μS or so that it takes for the lamp to reach steady state, but then is approximately constant. After the lamp is turned off, brightness fades rapidly, but a faint afterglow continues for several milliseconds. Light output falls to zero, though, before the end of the frame, which lasts 16.7mS.

These rise and decay characteristics are nonlinear, and are different for each colour. If uncorrected, these differences would unbalance the colour signals. Correction is applied by simple curve-shaping circuits with diodes to give segment approximation of desired characteristics in the three video amplifiers. Circuits of this type have long been used in analog computers as curve generators, and in television cameras for gamma correction.

Anyone who has had experience with tungsten filament light sources might worry that the lamp's light decays too slowly for this application. But this isn't a problem for the miniature lamps of the type used for dial lights. Luminance decay of these lamps is sufficiently short compared with the 16.7mS vertical scanning period of the television signal, because small filaments cool quickly.

One hope for future display panels is a p-n light-emitting junction. If an electroluminescent diode could now be produced more cheaply than the lamp plus a diode, perhaps by LSI (large scale integration) techniques, and made to produce the desired red-green-blue trio, then there would be no need for tungsten filament lamps. But today's diodes aren't bright enough, and blue luminescent diodes can't yet be produced. Also, costs are high and yields poor. ("Electronics," Vol. 41, No. 8.)

Considerable interest has been aroused by the recent announcement of a new type of three-beam, single-gun colour TV display tube by the Sony Corporation of Japan.

The new display tube — called the "Trinitron" — is claimed to be based on entirely different concepts to either the Shadowmask or Chromatron colour display tubes.

It is being claimed that the new techniques provide brighter pictures while the single gun may appreciably reduce manufacturing costs.

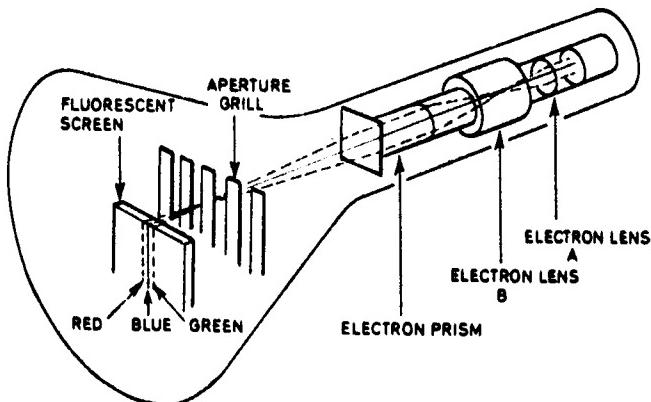
According to Sony engineers, the Trinitron system employs a single electron gun that emits three electron beams simultaneously, making them converge on systems of two large diameter electron lenses and two electron prisms.

The large diameter of these lenses is said to result in much greater brightness and picture sharpness.

A colour separation technique known as "aperture grill" has been developed with the co-operation of the Dainippon Screen Manufacturing Company of Kyoto. This aperture is said to ensure better transparency and so help improve picture brightness.

It is also claimed that the new display system is relatively simple to set up and converge.

Some reports indicate that Sony plan to show a colour receiver using a



13-inch Trinitron tube in New York in late May and to be preparing to market the receiver in Japan later this year, and in the United States in 1969.

The simplified receiver using the Trinitron is expected to be marketed in Japan for a little over £125. Sony is reported to have applied for more than 100 patents covering the new tube.

The accompanying diagram shows the main features of the Trinitron tube. Three beams are emitted from the single gun containing five grids, with three cathodes aligned directly behind three holes in the first grid. At the exit from the gun is a set of electrostatic convergence plates or prism. No convergence yoke is used.

It is claimed that the system operates with considerably greater beam current than the Shadowmask tube.

Sony also claim that greater brightness results from the use of the aperture grill in front of the colour strips on the faceplate. The aperture grill expands in the vertical direction, maintaining registration.

A 13-inch colour TV receiver using the Trinitron is said to consume only 65 watts of power.

No details of the cost of the new display tubes have yet been given, and Sony apparently intend to continue building sets having Chromatron type tubes.

EDITOR'S NOTE: From the foregoing, and the diagram, it would appear that the basic differences between this tube and the conventional Shadowmask tube are that the phosphor is laid down in vertical parallel lines, with the red, blue and green phosphors, alternating and that the Shadowmask is replaced by a vertical grille, so placed that it is at the focal point of the three converging beams, and at the right distance from the phosphor for the three beams to spread the right amount to fall on their correct phosphors. Expansion of the grill caused by temperature difference is mainly in the vertical direction, so that beam registration is not significantly affected. ■



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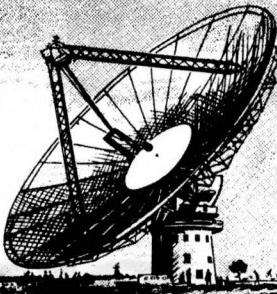
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SCIENTIFIC AND INDUSTRIAL NEWS



Undersea oil storage

Blasting of undersea oil storage caverns using small nuclear charges has been proposed by an American expert as a means of solving the oil industry's storage problems. Speaking at an ocean engineering symposium arranged by the American and Puerto Rican Institutes of Chemical Engineers, Dr Harold F. Plank, Lockheed Missiles and Space Company nuclear expert, stated:

"Nuclear blasts could help solve the oil industry's storage problems even in oil fields a hundred miles or more offshore. The ability to store offshore oil where it is found rather than pipe it many miles to shore could save petroleum producers many millions of dollars. The simplest approach would be to use a ship from which to drill small diameter holes to the desired storage depth in an offshore field, lower a small nuclear charge through one of the holes and detonate it to create a cavity perhaps 300 feet wide and 500 feet deep.

"Then two sets of lines would be run through other drilled holes — oil lines into the top of the cavity and water lines into the bottom. Oil pumped to the platform above from nearby wells would be pumped into the cavity.

"Sea water flowing through the lines into the bottom of the cavity would force the oil continually upward keeping it near to extraction lines and ready to be drawn out for shipping at any time."

Plank said the top of an offshore cavity could be about 1,200 feet below the ocean floor. He emphasised there would be virtually no danger of nuclear contaminants leaking into the ocean or atmosphere.

Aircraft research in U.S.A.

Scientists at the Materials Sciences Laboratory of the Lockheed-Georgia Company, Marietta, Georgia, 424-2269, U.S.A., are developing coating compounds to improve fatigue life of metals. Development tests on various coating compounds indicate that significant improvements in fatigue endurance can be realised on titanium and high-strength steels, which are vital to the design of advanced airliners now being developed.

Further research will couple corrosion resistance characteristics with present fatigue coating systems. The multi-purpose coatings may be developed for application to metals in paints or sealing compounds.

Another company in the Lockheed group — Lockheed

California Company, Burbank, California 847-6815, U.S.A. — is working on the design of plastic aircraft, in co-operation with the U.S. Air Force Materials Laboratory. The properties of boron fibres and similar filaments hold promise for airframes of great structural strength and significant weight reduction — perhaps one-third lower than present-day types of comparable size. Advanced composite materials have been under investigation at Burbank since 1959.

Initial experimental work in monofilament composites used steel music wire in an epoxy matrix. Later development explored the use of large diameter glass filaments. Boron fibre research at Lockheed has led to manufacture of an aircraft part — a fire access door on the F-104 jet Starfighter — made of boron epoxy laminate. Five of the doors will be put through a variety of laboratory and flight tests anticipating future application of the new materials to production.

Electric field shark barrier

A new form of shark barrier developed by South African scientists, which uses electrical fields instead of the usual net barriers, was described recently in "The New Scientist" (Vol. 37, No. 588). Since net barriers are costly to maintain and install, they are restricted to the more populous beaches. The South African scientists have been investigating the possibilities of electrical barriers for some time, and have now invented a new system which should prove to be cheaper to make than a prototype system erected three years ago.

The earlier system consisted of two electrodes in cable form connected by a cable grid. It was based on the principle that fish always swim toward the positive pole in an electrical field. The barrier was placed across the mouth of a river, and it is claimed that sharks making for the beach inside the barrier were forced back by involuntarily muscular contractions. The barrier proved to be so effective that not one shark was found on the landward side of the barrier when the current was switched on.

When studying the system in operation, the scientists noted that sharks were turning away before reaching the electric field. They deduced that even the small amount of electricity outside the field was repelling them and this was proved by further tests in shark tanks. As a result a system using a single cable has been tried and found to be effective. This is cheaper to install and maintain. The device uses only a small amount of current which presents no hazard to bathers. No further details about the method of arrangement of the cables and power supply were given in the report.

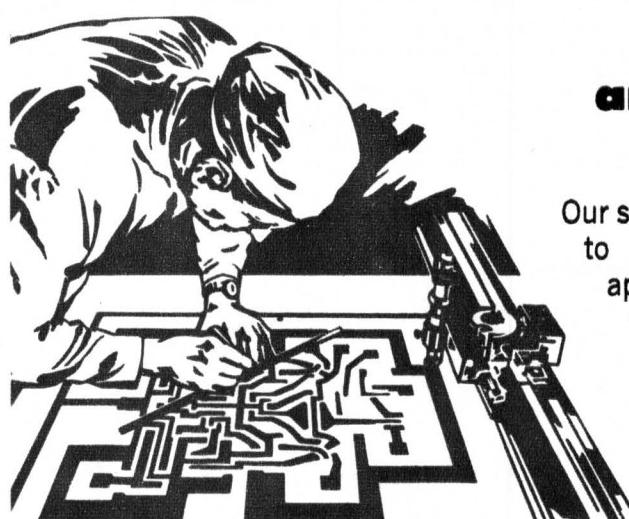
Saving two-car accident victims from hours of agony, pinpointing bushfires, reporting a tree fallen across a roadway, reporting vandalism of park property . . . these are only a few of the important messages carried in fictional situations by a Weston Electronics radio network in the all-Australian television series "Skippy, the Bush Kangaroo." But the equipment seen here in action during filming is not entirely a "stage prop" since it also plays an active role in controlling the production team and ensuring co-ordinated filming. Fauna Productions Pty. Ltd., who produce the series, use a 50W base station and two marine transceivers to work in conjunction with mobile sets in vehicles and a helicopter to achieve good communications during filming in the difficult terrain of the Kurin-gai Chase, north of Sydney.



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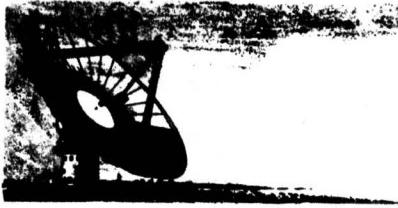
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Improved seismic research

A new offshore seismic exploration system, providing much clearer definition of potential oil and gas-bearing layers down to 15,000ft below the earth's surface, is being employed for the first time in Australian waters by the Western Geophysical Company. The system, known as Aquapulse, has a high degree of accuracy which reduces the need to repeat the same course twice in problem areas, while its deep penetration increases the chance of discovering oil. Instead of conventional explosives, the Aquapulse method employs oxygen and propane gas.

These gases are mixed and detonated below the surface inside a tough rubber "bladder" or container. The sudden expansion of the elastic-walled container creates a powerful pressure pulse which is much more defined and better controlled than the conventional underwater explosion of a 50lb dynamite charge.

The Aquapulse system, developed by Esso Production Research Company and licensed exclusively to Western Geophysical, a division of Litton Industries, has already been used successfully in the Gulf of Papua in seismic exploration for Phillips Australian Oil Company. Western Geophysical has also completed Aquapulse surveys off the west coast of New Zealand for Esso and is now operating with the system in Bass Strait.

Radio-controlled pantograph

Electronic pantograph equipment connected by VHF radio link is being used in a British shipyard for communication between work teams and office staff. The equipment, consisting of Electrowriter units made by Modern Telephones (Great Britain) Ltd., and VHF radio link supplied by Pye Telecommunications Ltd., is being used in Southampton Docks by the repairs division of Vosper Thornycroft Group. The Electrowriter reproduces messages and sketches written at the transmitting machine. Normally a Post Office line or private land line is used for interconnection, but in this instance, where repair gangs are working in various parts of a busy dock complex, land line is not feasible.

The Electrowriter used in this system is described as an "electro-mechanical pantograph." The writing pen at the transmitting machine is connected to a pantographic device which translates movement of the pen into X-Y data which is transmitted to the receiver by a pair of wires, or, as in this case, by radio link. The transmitted data is used to re-create the movement of the writing pen at the receiver. It is therefore not a true facsimile machine, and is able to transmit only line data, but this is adequate for the transfer of written messages and simple line drawings.

Sydney ILS nears completion

The new instrument landing system (ILS) supplied by Standard Telephones and Cables for Sydney's Kingsford Smith Airport has been successfully tested and will be brought into operation progressively as the extended north-south runway comes into service. When it is in full operation, it will be possible, in theory, for a pilot to bring his aircraft right down on the runway in zero visibility. When used with an airborne computer, it is possible for an automatic pilot to make a "no hands" landing. In practice, neither of these two possibilities

will happen, but the new equipment will make a major contribution to the safety of aircraft landing in conditions of poor visibility and bad weather.

This latest type of ILS has been developed from a system originally evolved during the World War II and progressively improved in the intervening years. The major parts are the Localiser, used to indicate the position of the centre line of the runway; and the Glide Path Indicator, which gives the correct descent angle to be followed by the aircraft when landing.

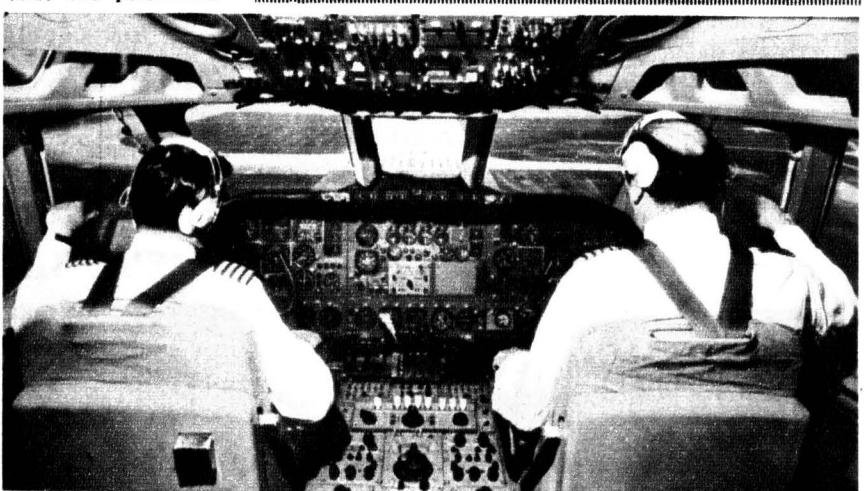
The relative information for both these indications is transmitted to the aircraft by a carrier frequency modulated by two signal frequencies. These signals are detected by receivers in the aircraft and displayed on centre zero meters on the instrument panels. As long as the aircraft is flying on the correct centre line and glide path the meters will give a zero reading, but any deviations will cause the indicator needle to deflect.

Both indications are displayed on a single instrument, called a cross pointer indicator. The needles are mounted at right angles, and when the aircraft is correctly aligned on the centre line and glide path, the needles will cross at the centre of the indicator dial. By flying so that the cross-pointer indicator needles are kept centred, the pilot can bring his aircraft almost to touchdown point without actually seeing the runway.

New research laboratory



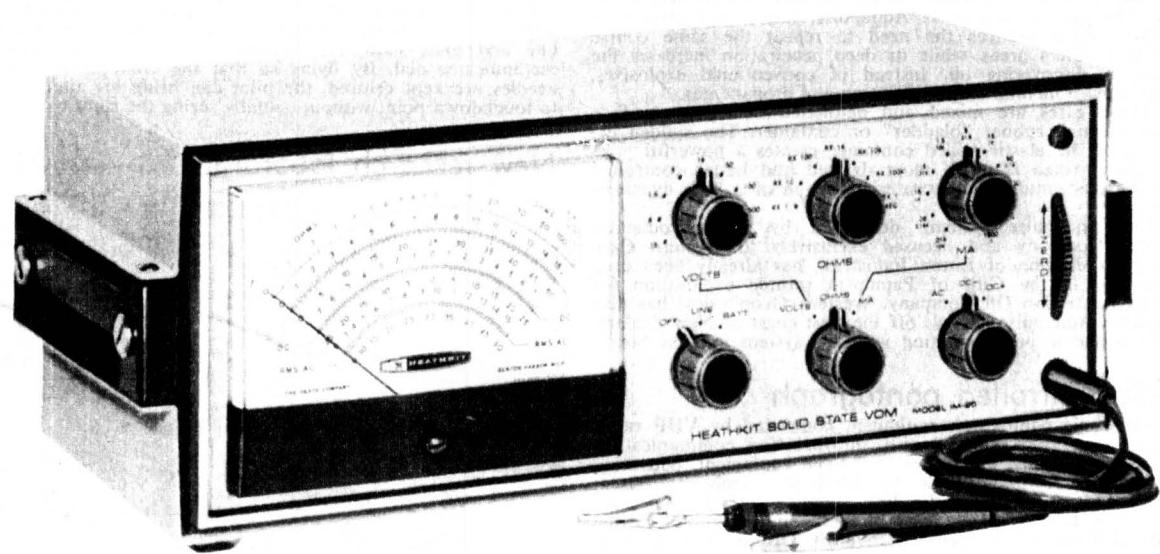
A new research laboratory has been established in Melbourne by Distributors Corporation Pty. Ltd., 24 Johnston Street, Fitzroy, 3065. This will allow special research projects to be undertaken, particularly in the fields of system engineering. Until now, the company has been engaged mainly in providing sales and support work to Government contractors purchasing equipment from General Dynamics Electronics, Gerber Scientific Instrument Company and the Singer-Metrics group of the U.S.A. The new facilities will allow Australian specialist teams to work in close partnership with General Dynamics and Singer-Metrics in the future. Shown here in a section of the laboratory are Mr Jack Phelan, of General Dynamics (centre), Dr Guido Ricciardi, of Elmer S.P.A., Italy (right), and Mr John Cummin, chief engineer of Distributor's electronics division.



ILS in action

Although the aircraft whose cockpit is pictured here is only seconds away from touchdown at London Airport, both pilots have their hands right away from the controls. It is a B.O.A.C. VC10 equipped with a British Aircraft Corporation-Elliott automatic landing system and is being guided down the ILS beams to which the automatic pilot is locked. An ILS system is currently undergoing tests at Sydney Airport, as reported in the news item above.

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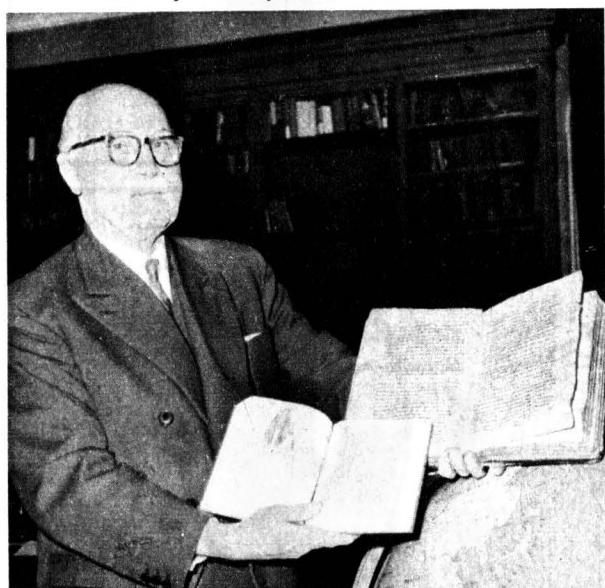


N.S.W. Safety Convention, 1968

The Twelfth N.S.W. Industrial Safety Convention and Exhibition will be held at Macquarie University, North Ryde, over three days, August 19-21. The theme of the convention is "Safety Is No Accident." A wide variety of safety equipment will be shown in the exhibition and a number of safety films will be shown. On August 19, a special evening session will be devoted to domestic safety, which will include lectures on heating appliances, lawn mowers, poisons and the use of electricity. Other sessions over the three-day period will cover a variety of technical subjects, occupational health, and safety in Government departments.

Technical sessions will deal with the chemical industry, safety aspects of manufacturing, respiratory protection, inflammable liquids, static electricity hazards, insurance liability, workers' compensation, and small arms safety. Occupational Health sessions will be handled by a panel of industrial doctors who will discuss health aspects in dusty occupations, prevention of industrial dermatitis, toxic effects of metals and other related subjects. Plenary sessions will deal with Communications in Safety, Industrial Noise Control, Productivity and Safety, and the Scope of Industrial Health Services. A special feature of the convention will be a forum jointly arranged by the Labour Council of New South Wales and the Metal Trades Employers' Association.

Bible set by computer



Brigadier Charles C. Swift, O.B.E., M.C., chairman of the General Committee of the British and Foreign Bible Society, is holding in one hand the first computer set Bible and in the other an old eighth century edition. All the information for setting the 1,200 pages of the Revised Standard Version are stored on 4,000ft of magnetic tape stored on two reels. Over 10 miles of paper tape was used as input to the computer. This edition of the Bible, which is profusely illustrated with drawings and maps, costs only 12/6 in U.K. and the whole first run was sold out within a short period.

Better space aerials

Engineers of The Marconi Company, of U.K., have perfected a new type of pivot assembly for the huge dish aerials used in space communications ground terminals, some of which weigh 100 tons or more. The company claims that this represents a major breakthrough in the mechanical reliability of the aerial structures, and puts Britain ahead of the rest of the world in

this field. In the Marconi system, metal ball or roller bearings are replaced by sliding surfaces made of a synthetic material.

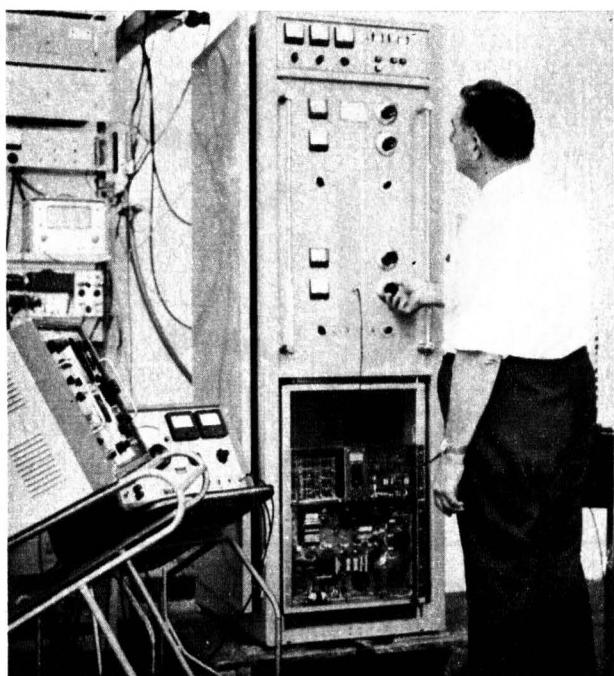
It is the aerial structures which cause space communications engineers most concern, since a breakdown could put a station out of action for several weeks, causing a serious diversion of communications traffic to alternative systems. System failure in electronic equipment can be overcome by duplication, but this approach is not feasible with main bearing structures. The new Marconi development makes it possible for the first time to rectify any fault in the bearing system in less than a day, and in some cases it may be possible for the station to continue operation while repairs are carried out. This means that communications authorities can now rely on continuity of satellite services for months and even years, without risk of interruption. It also means that a station no longer needs to hold a spare bearing costing thousands of dollars. Instead, a pad assembly costing only a few hundred dollars is all that is necessary.

In the Marconi design, the dish, its back structure and mechanism to move it through 90 degrees in elevation are all mounted on a "kingpost." This is a tapered assembly resembling an inverted cone. The kingpost fits into a mating cavity in the aerial's concrete base structure. Bearings at the lower end of the kingpost, and also at the point where it joins the dish assembly, permit the structure to rotate about a vertical axis without restriction. Plastic sliding bearings are used at each end of the kingpost, and these are coated with extremely low-friction material. Pads of this material slide on metal tracks at the top of the kingpost, and a similar system at the lower end takes the weight of the system and also carries the lateral forces caused by the dish pivoting about the upper bearing.

The design uses six pads for the upper bearing, placed around the circumference of the kingpost, and provision is made for adjusting each pad independently. Access is provided inside the kingpost while the equipment is operational for examination and servicing of the pads. With pads removed, the station can continue operation. Immediately below these pads, locking jacks can be extended to relieve pressure on all pads and to hold the dish structure during typhoon conditions. The lower bearing employs two sets of pads. One set, placed horizontally and sliding against a track on the base of the kingpost, takes the weight of the moving structure. Around the rim of the base, a second set of pads takes up the transverse forces.

The whole of this lower kingpost bearing is immersed in oil. However, even if the oil is drained away, wear and friction is so low that the station can continue to operate. All the pads can be removed and replaced with the station in operation. All bearing surfaces are designed with an inbuilt self-aligning feature which ensures that each pad takes an equal load. Very quick replacement of all bearing pads is provided by this feature.

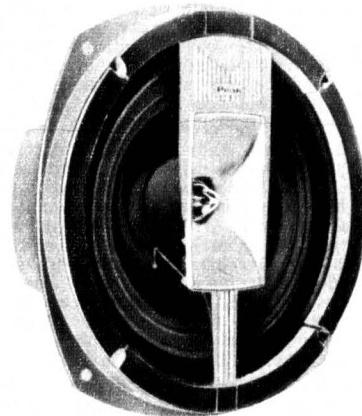
DCA buys Australian



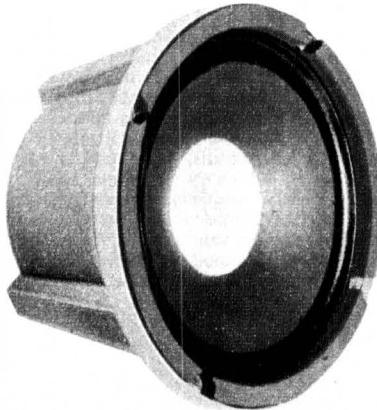
Noel Millar, head of production at the Brookvale, N.S.W., plant of C.E. Electronics Pty. Ltd., inspects a 1KW dual channel RF amplifier, one of a batch being supplied to the Department of Civil Aviation, and the 150th of the current order. The amplifiers are used by D.C.A. for ground-to-air and point-to-point voice and telegraph communication.

PEAK

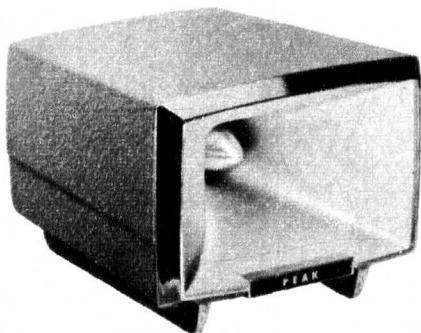
hi-fi speakers



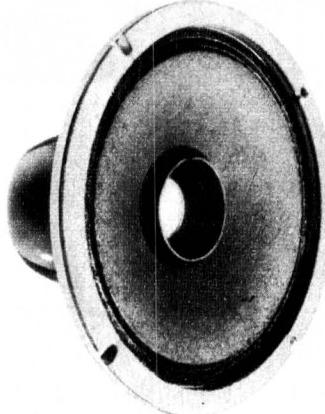
TWIN SPEAKER — FULL RANGE
8CX-50 8" 30-22,000 Hz 15 W \$31.50
10CX-50 10" 25-22,000 Hz 20 W \$48.00



HIGH COMPLIANCE WOOFER
6M-50 6" 200-6,000 Hz 25 W \$28.00
8L-50 8" 37-4,000 Hz 15 W \$37.75



HORN TWEETER
H-50 2000-20,000 Hz 15 W \$14.75



DUAL CONE — FULL RANGE
6A7 6" 60-16,000 Hz 5 W \$7.25
8A7 8" 50-16,000 Hz 8 W \$9.55

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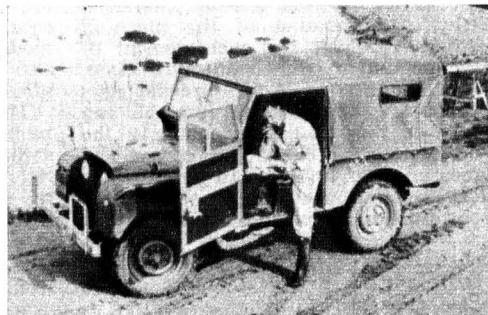
Computerised telephones

A number of Australian manufacturers are preparing tenders for the supply of electronic equipment for use in Australia's first computer-controlled telephone exchange, for which the Post Office called tenders recently. The exchange will be sited in Pitt Street, Sydney. It will be designed to carry the greatly increased trunk line traffic expected in the next ten years.

A spokesman for the Australian Telecommunications Development Association said that the advantages of computer control in telephone exchanges would be greater speed and flexibility, greater traffic handling capacity in less space and lower maintenance costs. He added that the Australian Post Office was keeping well up with overseas developments in telecommunications and he knew of only one computer-controlled exchange already in operation, which was in Belgium.

Ord River radiophones

The Public Works Department of W.A. has installed 25W mobile radiotelephones in each of the 25 vehicles used by its "watermen." The system, which was designed and installed by Philips Telecommunications of Australia Ltd., will enable the watermen to keep in touch with each other and with the control centre at Kununurra as they go about their work of controlling water flow to irrigation farms. The control centre has a 50W remotely-controlled base station which doubles as a talk-through repeater. The



base equipment is duplicated. Automatic equipment checks the system during idle periods and, if a fault is found, switches to standby equipment.

Emmy award goes to U.K.

Mr Peter Rainger, a B.B.C. design engineer, has won an Emmy award for his work on the design of the standards converter which converts American colour television signals to a form suitable for transmission over European networks. The award is made by the U.S. National Academy of Sciences. This is the first time an Emmy Award has been made to other than an American technologist.

Mr Rainger's standards converter is the only one in the world capable of converting colour television signals from the 525 line/60 field standards used in America to the 625 line/50 field standards of Europe. The converter has already been used in trans-Atlantic colour television programs with excellent results. The system was described in our November, 1967 issue (see Technical Review, page 25).

More radiophones for N.S.W. railways

A new modern radiotelephone control system now in use by the N.S.W. Department of Railways was supplied by Amalgamated Wireless (Australasia) Ltd. The equipment was custom built to the Department's specifications as part of a substantial contract for a new and improved radiotelephone system for the railway network.

The system will have two control units,

one sited in Sydney, the other in Lawson, west of Sydney in the Blue Mountains region. These will serve repeating base stations at Glenbrook, Leura, Newnes Junction, Cowan, Woy Woy, Sutherland and Chullora. This system will allow selective communication between the two control points, and to and from mobile telephones in road and rail vehicles, and portable units. The control points will be able to extend radio calls to and from the department's manual and automatic telephone networks.

All units will have duplex facilities, allowing complete access to and from the main bases and the various "way-side" bases by either radio link or landline, with full monitoring and supervisory facilities.

A.W.A. has also supplied 85 transistorised duplex "Carphone" radiotelephones, specially modified to meet some special requirements of the Railways Department, for use in road and rail vehicles.

Measuring minute motions

Movement as small as four 10-millionths of an inch are being measured by scientists of Lockheed Missiles and Space Company, Sunnyvale, California, 322-6688, U.S.A., using a gas laser. The technique is said to be particularly effective in measuring the motion of surfaces of unattached objects. The only contact with the

ROGERS CADET Mark Three



CHASSIS MODEL \$136.00

CASE MODEL \$150.00

The CADET III offers remarkable value for money and has become firmly established as the most popular medium-priced stereo amplifier on the British high-fidelity market. It combines versatile performance with attractive styling and permits the assembly of a complete home stereo system at a new low price.

TECHNICAL: Power Output: 10 plus 10 watts (sine wave), 12.5 watts (music power).

Harmonic Distortion: 5 watts .25 per cent at 1kc/s, 10 watts .8 per cent at 1 kc/s.

Output Impedance: 3.5 and 12.16 ohms. Operating voltage: 110-122-220-240 V.

Input Sensitivity: Radio: 100 m/V (470 K). Tape Replay: 600 m/V.

Disc (Magnetic): 3.8 m/V (68 K); (Crystal/Ceramic): 65 m/V (2 meg-ohms).

Tape Record Output: 600 m/V. (External load not less than 100 K.)

High Pass Filter: 60 c/s 10 dB per octave. Low Pass Filter: 6.5 kc/s 10 dB per octave.

Cross-talk: 42 dB 1,000 c/s. 26 dB 10,000 c/s. Balance Control: 9 dB range.

Valves: 4 x ECL86. 2 x BY114 (Amplifier). 3 x low noise ECC807 (Control Unit).

Dimensions: 10in x 6½in x 4in (Amplifier). 10½in x 4½in x 4½in (Control Unit). 11½in x 4½in (Front Panel). 11½in x 11in x 5½in (Case Model).

Weight: 10lb. (Amplifier); 4lb (Control Unit); 19lb (Case Model).

(Supplied with Installation and Operation Instructions and all necessary connectors.)

For further details please contact:

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A comprehensive Test Set for Transistors and Diodes

An up-to-date design suitable for general device testing in service workshops, development labs, technical colleges and by the home experimenter. It performs a variety of basic tests on diodes, silicon and germanium bipolar transistors, FETs and unijunctions.

by Jamieson Rowe

The transistor test set design to be described is virtually an amalgam of the group of basic test circuits which were given and discussed in last month's article. A single meter and power supply system are used, together with a switching system which permits multiple use of certain meter multipliers and shunts used in the various test circuits.

The resulting instrument combines a high order of functional flexibility with compactness and low cost. In addition it has been designed for straightforward and speedy operation, even by those with little experience in the operation of such instruments. It is hoped that these features will make the design of interest not only to service organisations but also to development laboratories, technical colleges and home experimenters.

The instrument provides 16 basic measurement ranges, of which five are concerned with bipolar transistors, four with field-effect transistors, three with diodes and four with unijunctions. In addition a number of further measurements may be made by suitable transposition of device connections.

The five bipolar transistor ranges provided allow testing of both germanium and silicon devices of either NPN or PNP construction, measuring in turn leakage currents I_{CBO} and I_{CEO} ,

DC current gain β or hFE , and breakdown voltages BV_{CBO} and BV_{CEO} . Additional tests which may be performed by transposition of the collector and emitter connections are measurement of I_{CBO} and BV_{CBO} , the leakage current and breakdown voltage of the emitter-base junction.

Either N-channel or P-channel FETs may be tested on the four FET ranges, of which the first two measure I_{DSS} and BV_{GSO} respectively. The two remaining ranges allow measurement of the device I_d - V_{GS} transfer characteristic, determination of the pinch-off voltage V_p and also measurement of the maximum transconductance G_m .

If it is desired to measure the gate-channel leakage current I_{GSS} this can also be measured, by connecting the device into the bipolar test circuit and measuring as for I_{CBO} . In this case the device selector switch is set for the corresponding bipolar device (NPN for an N-channel FET, PNP for a P-channel FET), and the drain and gate leads connected to the collector and base clips respectively.

Depletion-mode MOSFETs and other IGFETs may be tested on three of the FET ranges, but must not under any circumstances be given the test for BV_{GSO} —the reason being that the gate insulation of these devices cannot sustain breakdown without permanent

damage. Care should also be taken with these devices both when handling them, when inserting them into the test set (it is advisable to remove the mains plug when so doing) and when applying gate bias during I_d - V_{GS} measurements.

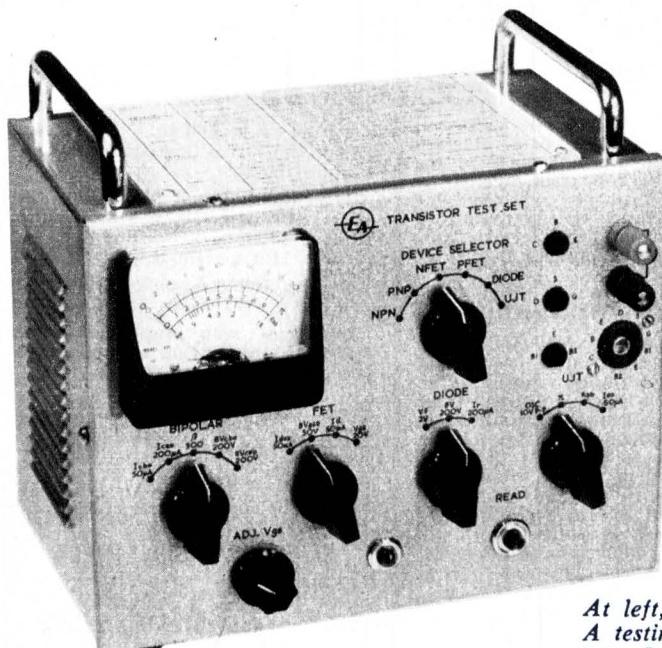
Both silicon and germanium diodes may be tested on the diode measurement ranges, which allow measurement of forward voltage V_f , breakdown voltage BV (up to 200V only), and reverse leakage I_r . The diode ranges are equally applicable to zener/reference diodes and to rectifier-type diodes, while the BV and I_r tests may also be used to test thyristors and silicon-controlled switches.

The four remaining measuring ranges deal with unijunctions (UJTs), and consist of a relaxation oscillator test together with measurements of the interbase resistance R_{BB} , the intrinsic standoff ratio η and the emitter junction leakage current I_{EO} .

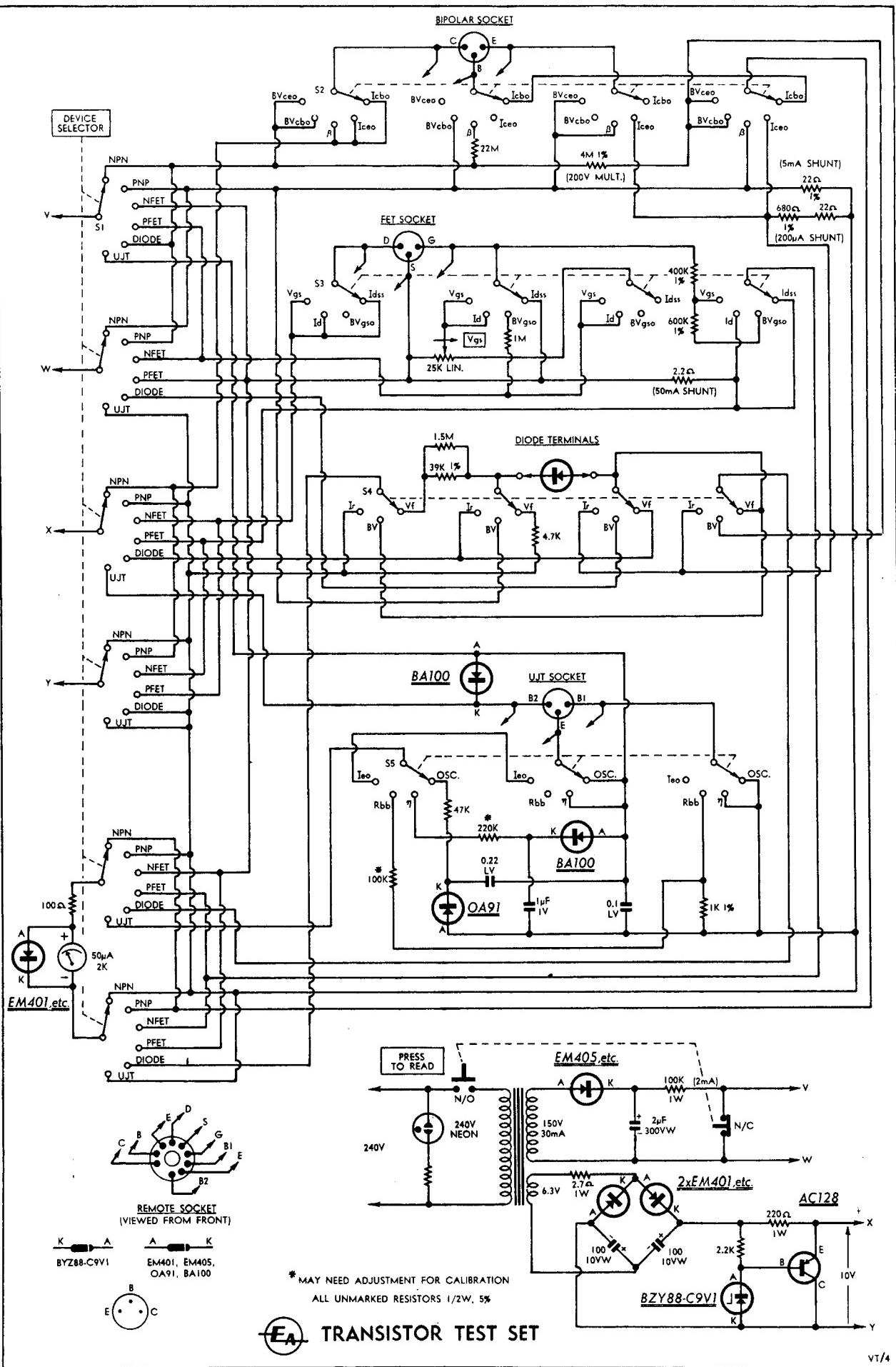
As noted, the operation of the instrument is straightforward. Separate panel connectors are provided for each of the four types of device, the connection conventions being in each case those observed by a majority of manufacturers. After insertion of the device, a selector switch permits selection of the appropriate test circuit and supply and metering polarities. The appropriate tests may then be performed speedily using one of four coded test selectors, together with a "read" pushbutton.

Use of a "read" pushbutton ensures that test voltages are not applied to a device while it is being inserted into the instrument connector; it also tends to ensure that tests which may be inappropriate or damaging to a particular device are not applied unless consciously applied by the operator. And, finally, it ensures that low-power devices may not be left connected into a test involving appreciable power dissipation while the operator searches for a data manual or walks off for a tea-break!

The switching circuitry of the instrument is arranged so that measurement readings taken on the tests for a particular type of device are not affected by the settings of the switches used for other devices, PROVIDED that other devices are not connected to the instrument when the tests are performed. If other devices are so connected during a test, errors may occur



At left, the completed test set as described in this article. A testing guide table is attached to the top to facilitate its use. Opposite is the full circuit diagram of the instrument.



**If you keep on making small improvements
in the design of a valve**

IT MAKES A BIG IMPROVEMENT TO THE WAY IT WORKS



Take our 6AU6, for example; it has been manufactured by A.W.V. for over 20 years. And our 1948 valve looks much the same as our 1968 one. But constant technological improvement has improved the quality, efficiency and operating life.

Here are some of the improvements—

Heater—Improved insulating material and tungsten processing greatly reduce hum and increase operating life.

Grids—Special chemical treatment of Grid 1 inhibits

oxide formation—considerably lengthens life.

Anode—Now made from gas-free aluminium clad iron instead of carbonised steel, thus increasing the life of the valve.

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Small changes? A.W.V. valves perform better and live longer because of them.



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on certain ranges and with certain switch setting combinations, as a result of the multiple use of meter shunts and multipliers.

To guard against premature obsolescence, the instrument is provided with a front-panel nine-pin socket, to which are brought duplicate connections to those of the transistor sockets. This will permit the use of adapter units having connection facilities of whatever type may be appropriate for future device packages. The socket will also permit the use of clip leads for remote testing.

From the main circuit diagram, it may be seen that the test set uses relatively few components. A single small power transformer is employed for the dual power supplies, the 150V secondary winding being used to provide the "constant current" supply and the 6.3V heater winding to provide the 10V supply. The former supply consists simply of a half-wave rectifier, while the latter employs a "full-wave" voltage-doubling rectifier followed by shunt voltage regulator circuit using an AC128 transistor and a BZY88-C9V1 zener diode (nominal 9.1V).

The meter movement is a 50uA/2K 3in rectangular type; the prototype instrument employs a Japanese-type VP-2A unit imported into this country by Electronic Supplies, of Box 417, P.O., Crown Street, 2010, and available from many suppliers. The meter is provided with overload protection by means of a series 100 ohm resistor and shunt silicon diode.

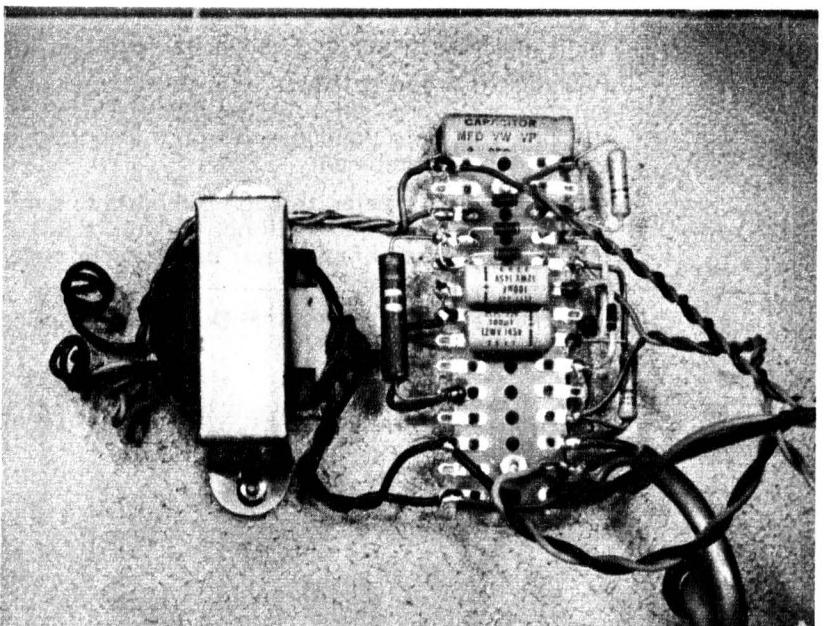
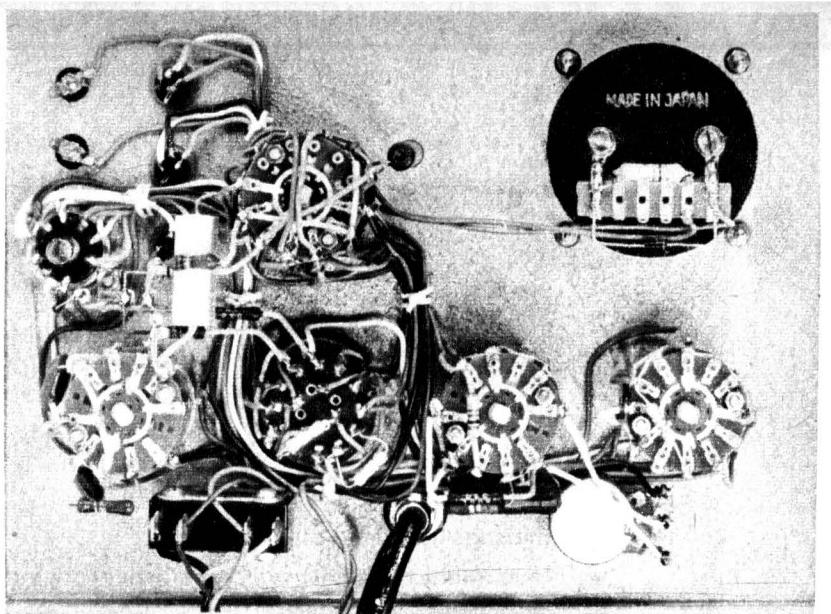
Switching of both power supplies and the meter to the appropriate test circuits is performed by switch S1, a six-pole, six-position rotary type which forms the "device selector" function. The individual tests for each type of device are then selected by S2, S3, S4 and S5, the circuits selected being in each case those previously discussed.

The "read" pushbutton is a double-pole microswitch type, one pole consisting of a normally open contact pair and the other a normally closed pair. The former pair are connected in series with the power transformer primary, while the latter pair are used to ensure that the output of the constant-current supply is clamped to zero when the button is released. A 240V neon lamp connected directly across the mains input is used as a pilot lamp for the instrument.

The transistor sockets used in the prototype instrument are McMurdo units designated type TS-8, which are available from most trade suppliers either ex stock or on order from the manufacturers. The sockets are supplied with a special toothed mounting ring, but in the absence of the appropriate staking tool we found it necessary to attach the sockets to the panel using epoxy resin cement.

From the photographs it may be seen that the instrument involves a moderate amount of wiring between the various selector switches. The few minor components employed in the test circuits are in general supported by the appropriate switch lugs; however, a miniature 4-lug tagstrip mounted on the rear of the panel adjacent to the remote socket is used to support two junctions which would otherwise be "floating." A miniature 6-lug strip is attached to the rear of the meter to support the protection components.

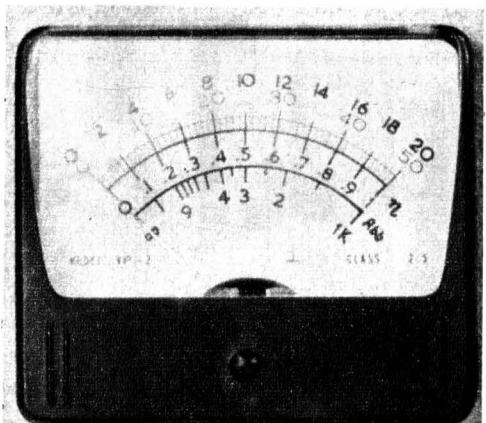
The power supply circuitry is attached to the inside rear of the case,



At top is a view of the rear of the test set front panel, showing most of the wiring and minor components. Beneath this is a view of the interior of the case, showing the power supply wiring. At right is a close-up of the meter face, showing the added scales.

with the minor components supported by a 14-lug section of miniature resistor panel.

Most of the components and wiring may be seen in the photographs; however, the wiring of the unit is not at all critical in terms of layout, and con-



structors need not be overly concerned with duplicating the prototype in this respect. As long as the usual precautions are taken concerning insulation and physical support, the wiring may be disposed largely as desired by the individual constructor.



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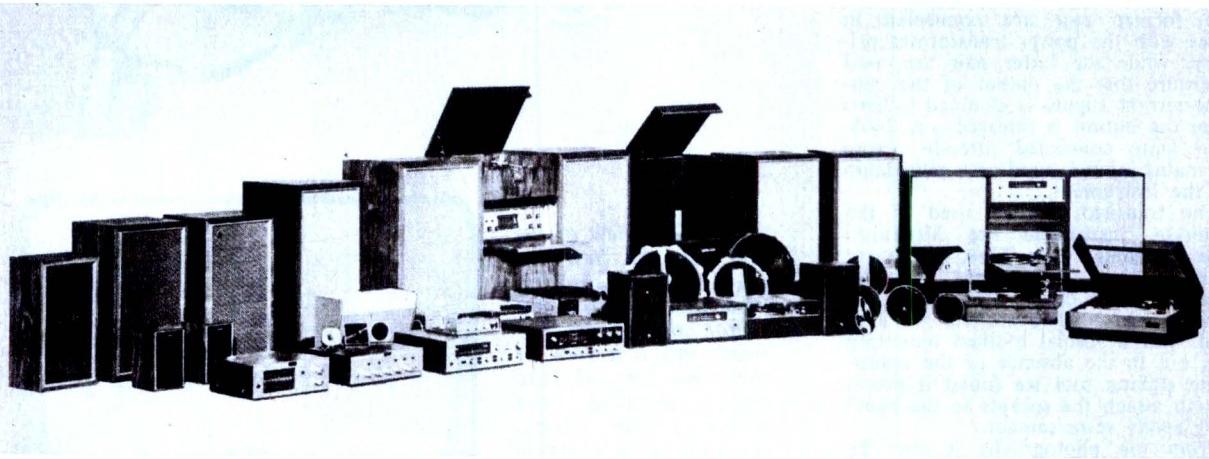
From the tiniest tweeter, through compacts to a mighty 150 watt concert-hall system, PIONEER has the unit to suit your needs and every speaker, amplifier, player or complete system is the best available in its class.

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SEE PIONEER!

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TRADE ENQUIRIES TO ASTRONIC IMPORTS, ALL STATES

DEVICE	TEST, CONDITIONS	COMMENTS
BIPOLAR TRANSISTORS (NPN, PNP)	I _{cbo} (-10V)	Silicon: normally less than 5μA at room temperature. Germanium: Should be 30-40μA or less; higher doubtful. HARD F.S.D. INDICATES COLLECTOR-BASE SHORT.
	I _{ceo} (-10V)	Silicon: 20μA or less good; unless v. high gain, higher readings suggest fault. Germanium: high gain devices may give readings approaching F.S.D. (HARD F.S.D. SUGGESTS SHORT)
	β (I _b =10μA)	Reading should fall within maker's range for h _{FE} . Zero or very low reading suggests open circuited base.
	BV _{cbo} (-2mA)	Usually highest breakdown voltage of device. (Zero=C-B SHORT)
	BV _{ceo} (-2mA)	This reading should be that used to determine device suitability for a circuit unless full circuit behaviour is known. Normally less than BV _{cbo} . (Zero=SHORDED C-E)
DIODES	V _f (+2mA)	0.35-0.55V for Germanium, 0.5-0.9V for Silicon. Zero reading=SHORT; F.S.D.=OPEN CIRCUIT.
	BV (-2mA)	For normal diodes, sets limit to in-circuit P.I.V. For zeners and regulators, shows approx. working voltage.
	I _r (-10V)	Gives an indication of the back resistance. F.S.D.=High leakage or SHORT.
FETS (N-channel, P-channel)	I _{dss} (+10V)	High reading predicts difficulty in obtaining useful gain at acceptable current levels. F.S.D.=DRAIN-SOURCE SHORT.
	BV _{gso} (-200μA)	MUST NOT BE APPLIED TO MOSFETS OR OTHER IGFETs. For JFETs, shows absolute limit to gate-source bias voltage. Zero=GATE-SOURCE SHORT.
	I _d (+10V)	Reads channel current as a function of -V _{gs} . Reduce I _d to near-zero using V _{gs} control to find V _p . NO VARIATION=GATE OPEN-CIRCUITED.
	-V _{gs} (+10V)	Reads gate reverse bias to permit plotting I _d /V _{gs} and determination of V _p . (For JFETs G _m =max. gain=I _{dss} /0.5V _p)
UJTS	OSC (+10V)	Reading is a measure of device "activity." Zero suggests device faulty.
	η (+10V)	Internal interbase divider ratio. F.S.D.=EMITTER OPEN CIRCUIT. Zero=EMITTER-B1 SHORT.
	R _{bb} (+10V)	Interbase resistance, typically around 3K. F.S.D. suggests probable short; zero=OPEN CIRCUIT.
	I _{eo} (-10V)	Emitter junction reverse leakage, should be less than 15μA. F.S.D.=SHORDED.

In view of the amount of inter-switch wiring involved, constructors may find it worthwhile to use hook-up wire of various colours to distinguish positive and negative supply leads, meter positive and negative, the various transistor electrodes, and so on. In any case it is usually advisable to wire up a project of this type in a methodical fashion, wiring in the connections for each individual test circuit in turn. Errors may often be avoided by wiring each test with the appropriate switches set for the test concerned, so that the switch rotors act as a guide when the connections are made to the stator lugs.

The meter movement as supplied has only a single 0-50μA scale, so that to facilitate convenient reading it is necessary to add further scales and legends. As may be seen from the front-panel photograph, the prototype meter has an added 0-1 scale for Eta, a resistance scale for R_{bb} and a second 0-20 legend above the original scale figures. These were added to the existing meter face using a small lettering stencil and matching tubular-knob drafting pen. The prototype face is reproduced a little less than actual size to serve as a guide to constructors in providing their meter with similar scales.

To prevent strain on the mains cord terminations the cord is clamped upon entry into the case, using a small clip fashioned from scrap aluminium. The cord entry hole is fitted with a grommet to prevent chafing.

When the instrument has been completed it will be necessary to perform

COMPONENTS LIST FOR TRANSISTOR TEST SET

- 1 Instrument case, 9½in x 6½in x 5¼in, with wrap-over front panel.
 - 1 50μA panel meter, 3in rectangular type.
 - 1 Power transformer, 240V to 150V at 30mA, 6.3V at 1A.
 - 1 3-section 2-pole 6-position rotary switch.
 - 1 2-section 2-pole 5-position rotary switch.
 - 2 2-section 2-pole 4-position rotary switches.
 - 1 4-pole 3-position rotary switch.
 - 1 Pushbutton microswitch, two poles converse-acting.
 - 1 Neon pilot bezel, 240V type.
 - 3 Transistor sockets.
 - 1 Spring terminals, 1 red 1 black.
 - 1 Miniature 9-pin valve socket.
 - 5 Bar-type control knobs.
 - 1 Small fluted control knob.
- SEMICONDUCTORS**
- 1 Silicon diode type EM405, AD4005, 1N3195, OA650 or similar.
 - 3 Silicon diodes type EM401, AD4001, 1N3193, OA65 or similar.
 - 2 Silicon diodes type BA100 or similar.
- RESISTORS**
- 5% tolerance types: 2.2 ohms, 2.7 ohms 1W, 22 ohms, 100 ohms, 220 ohms 1W, 2.2K, 4.7K, 47K, 100K, 100K 1W, 220K, 1M, 1.5M, 22M.
 - 1% high stability types: 22 ohms, 680 ohms, 1K, 39K, 400K, 600K, 4M.
 - 25K linear pot.
- CAPACITORS**
- 1 0.1μF LV plastic.
 - 1 0.22μF LV plastic.
 - 1 1.0μF LV plastic.
 - 1 2.0μF 200mV electro.
 - 1 8.0μF 300VW electro.
 - 2 100μF 10VW electro.
- MISCELLANEOUS**
- 14-lug length of miniature resistor panel; 6-lug miniature tagstrip; 4-lug miniature tagstrip; mains cord and plug; grommet and cord clamp; case handles and rubber feet; connecting wire, solder nuts, bolts.

a small job of calibration before it is ready for use. Only two ranges need to be individually calibrated, these being the Eta and R_{bb} ranges for unijunctions.

The Eta range is calibrated simply by tailoring the value of the meter multiplier resistor (220K on circuit) until the meter reads F.S.D. with no device inserted. Calibration of the R_{bb}



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	MRX-108	1 POLE	1A	1-8 USABLE POSITIONS
	MRX-204	2 POLE	1A	1-4 USABLE POSITIONS
	MRX-402	4 POLE	1A	2 POSITION
TOGGLE	S-2012	SPDT	5A	ON-ON
	S-2013	SPDT	2A	ON-OFF-ON
	S-2022	DPDT	5A	ON-ON
	S-2023	DPDT	3A	ON-OFF-ON
	S-2025	DPDT	3A	ON-MOM ON
	S-2042	4PDT	5A	ON-ON
	S-2043	4PDT	3A	ON-OFF-ON
PUSH BUTTON	SB-2011	SPDT	2A	ON-ON (MOMENTARY)
	SB-2061	DPDT	3A	ON-ON (MOMENTARY)
	SB-2065	SPDT	2A	ON-ON (DOUBLE ACTION)
	SB-2085	DPDT	3A	ON-ON (DOUBLE ACTION)
SEE SAW	SW-3012	SPDT	3A	ON-ON
LAMP LIGHTED	MLB-2061*	DPDT	3A	ON-ON (MOMENTARY)
	MLB-2085*	DPDT	3A	ON-ON (DOUBLE ACTION)

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range is almost as simple, the corresponding multiplier (100K on circuit) being similarly adjusted until F.S.D. is produced with a 1K resistor connected to the UJT socket between the B1 and B2 clips. In each case the device selector must be set to "UJT," the UJT test switch set to the appropriate test position, and the "read" button depressed.

To facilitate rapid and efficient use of the completed instrument we have prepared a concise testing guide table, which is reproduced on these pages. The table gives the tests available for each device type in the usual order of application, the test conditions and brief comments regarding the results to be expected and their implications.

A photographic reproduction of this table has been attached to the top of the prototype instrument, as may be seen in the photographs, and this has been found a worthwhile aid to instrument operation. To aid readers who may care to attach a similar reproduction to their instrument we are making these available via the Information Service at a fee of 50c to cover the cost of materials and postage. A sheet of Perspex was used on the prototype to protect the table from damage or wear.

There are only a few points to bear in mind when operating the completed test set, the instrument having been designed so that its operation is more or less self-explanatory. The first point to note is that before a device is connected for testing its connections should be checked from the manufacturer's data.

The test sockets of the unit have been arranged so that the connections correspond to the lead configuration most commonly used. However, there will inevitably be devices whose connections differ from the usual, and which could be damaged by improper connection to the test set, so that a check with the manufacturer's data is usually advisable.

Where devices are fitted with additional connections such as shields, case leads, or "substrate" leads, these should normally be connected to the device electrode which in most applications is common to both "input" and "output" circuits.

A further point worth checking by reference to the manufacturer's data is the device polarity—NPN vs. PNP, or N-channel vs. P-channel, etc. Among the many hundreds of semiconductor devices now available there are many quite different devices, of opposite polarities, which nevertheless have very similar type numbers; relying upon memory can therefore tend to be rather unreliable. Although it is unlikely that a device would be damaged by inadvertent testing with reversed polarities, at the very least this situation might lead one to falsely reject a good device.

When testing bipolar transistors and diodes, particularly those of the germanium variety, remember that junction leakage currents are highly temperature dependent. Many a germanium device has been rejected unjustly simply because it was unfortunate enough to be tested while still hot from operation or from a few minutes spent in the operator's hand. If there is any doubt in such cases, it is often worthwhile to allow the device a few minutes to "cool off."

SECONDARY BATTERIES—

Their Construction and Characteristics

By Charles H. Carr*

This is the first of two articles on various types of secondary batteries, ranging from portable appliance types to those used in heavy industry. As well as discussing the basic types, such as lead-acid, nickel iron, etc., the author also describes the different versions of each type, developed to suit particular applications. This part deals with the lead-acid battery.

Secondary batteries — also called storage batteries — store chemical energy instead of electrical energy. The internal and physical changes that take place during discharge must be completely reversible. Otherwise, the battery soon would fail. At the present state of the art there are two basic storage battery systems, based on the type of electrolyte used. Acid-electrolyte batteries must be kept charged; alkaline-electrolyte batteries can be stored for long periods in a discharged condition.

The lead-acid battery is the most widely known type. Many lead-acid batteries have grids of antimony or silver alloys. Others have calcium alloys. Nickel-iron and nickel-cadmium secondary batteries use alkaline electrolytes. Characteristics of these batteries now are discussed, to help users better to understand how they operate and to guide in selecting proper types for various applications.

The lead-acid battery is made in a variety of physical forms, ranging from very small to very large and using various forms of plate construction.

Grids: The grids support the active material of both negative and positive plates. The lead or lead-alloy of the positive plate also plays an important part in conducting electric current from the plate to the terminals because lead is some 10,000 times less electrically resistive than the lead dioxide (PbO_2) active material.

Plates: A paste of lead sulphate ($PbSO_4$) — made by mixing PbO_2 and H_2SO_4 — is applied to the positive and negative grids of flat-plate-type batteries (figure 1). In tubular-type positive plates (figure 2), the porous tubes are filled with lead sulphate. Manchester-type positive plates (figure 3) have rolled buttons (rosettes) of pure lead strips inserted into the holes of the grid structure. After the plates have thus been assembled, the chemical compositions of the metals of the negative and positives are made dissimilar by means of "formation." Plates are "formed" by placing alternate positives and negatives in tanks of dilute sulphuric acid. The positive plates are used as anodes and electrolytically oxidized. Negative plates are used as cathodes and electrolytically

reduced. The lead sulphate is changed to lead dioxide (PbO_2) in the positive plates and to spongy lead (Pb) in the negatives.

Straps: The positive and negative plates are separately connected together by alloy straps which provide the external connecting posts or terminals. The plates thus are joined together in an element varying from three (two positives, one negative) in a fire alarm cell to 65 in a submarine cell.

Separators and Retainers: The positive and negative plates must not come in contact with each other and are prevented from doing so by means of separators and retainers. Materials

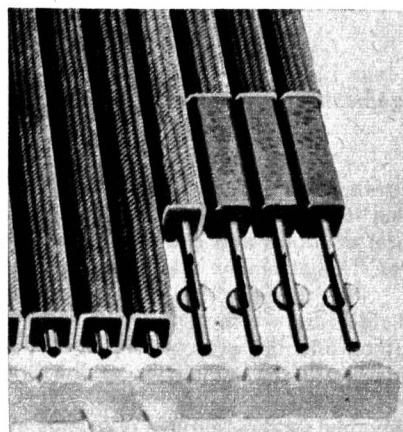


Figure 1. A partially pasted battery plate, showing how the active material is pasted into a lead grid structure. The active material is a mixture of lead dioxide and sulphuric acid.

such as rubber and plastic are used to insulate the plates. Separators must allow free flow of the electrolyte and electrons and, at the same time, retain the negative active material. The separators are made microporous during manufacture. The pores, of irregular shape, are processed into the materials and are less than one thousandth of one millimeter in diameter. Glass-fibre mat retainers serve to hold the active material at the positive plates in flat-plate batteries.

Electrolyte: The electrolyte is dilute sulphuric acid ($H_2O + H_2SO_4$). Specific gravities range from 1.200 to 1.300 depending upon the type of service.

Container: The container, or jar, houses the element and electrolyte. Containers of hard rubber — widely

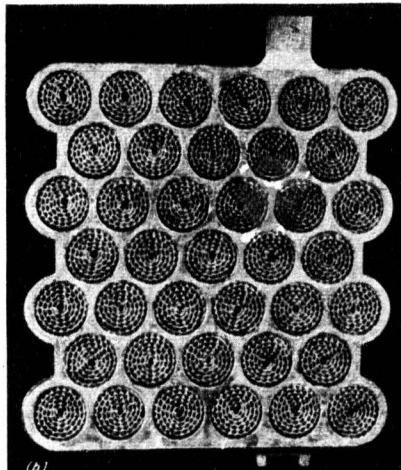


Figure 3. The Manchester type positive plate. Rolled buttons (rosettes) of pure lead strips are inserted in the holes of the grid structure. This type of plate has a very high effective surface area.

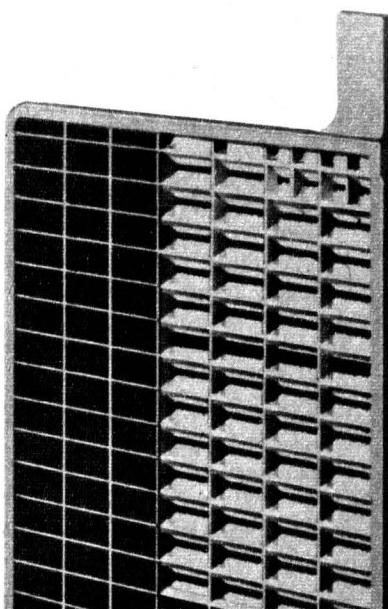
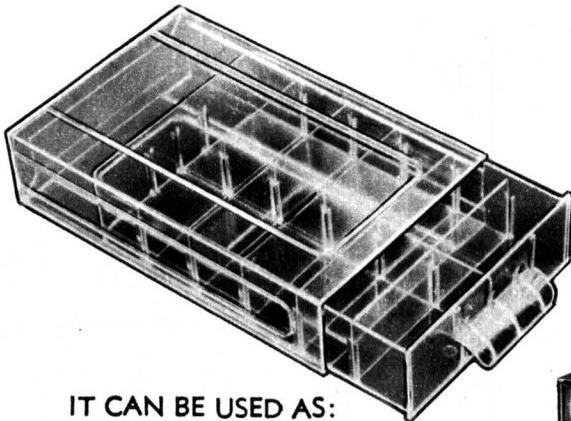


Figure 2. Portion of a tubular positive plate with a section cut away to show how the porous tubes are filled with a paste of active material.

*Assistant Technical Director, ESB Incorporated, U.S.A. (Formerly: The Electric Storage Battery Company).

MULTIDRAWER

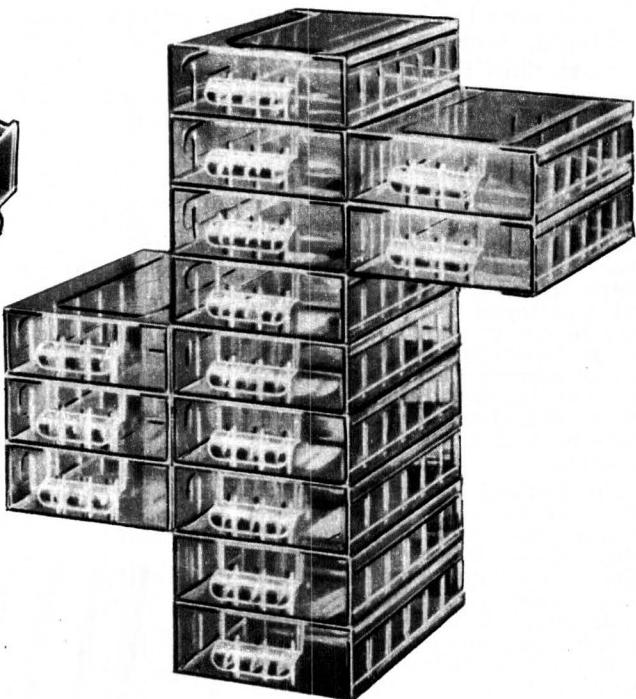
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used in automotive and motive power batteries — and clear plastic containers for stationary service are made in many configurations.

Connectors: Individual battery cells are joined together by means of metal connectors. The voltage of the battery depends upon the number of cells thus connected together.

In a fully charged cell, the specific gravity of the electrolyte is at its maximum. When the cell is discharging, the sulphate ion (SO_4^{2-}) in the electrolyte combines with the active material of both positive and negative plates to form lead sulphate (PbSO_4). The hydrogen (H_2) liberated from the electrolyte combines with oxygen (O_2) liberated from the lead dioxide to form water which dilutes the electrolyte and lowers the specific gravity.

During charge, the lead sulphate (PbSO_4) of the positive and negative plates reconverts to lead dioxide (PbO_2) and spongy lead (Pb) respectively. The electrolyte gradually increases in specific gravity as the sulphate ions recombine with hydrogen to form sulphuric acid (H_2SO_4).

The evolution from fully charged condition to discharged condition and back is known as a cycle. During charge, the positive plate has a tendency to shed a small amount of its active material. Unless the material is retained mechanically at the plate, a sediment gradually builds up at the bottom of the container. This not only represents a loss of active material, and consequent loss of capacity, but also creates the risk of short circuit should the depth of sediment exceed the space allowed for it by the manufacturer.

During recharge, a small amount of lead sulphate on the negative plate fails to be reconverted to spongy lead. Thus the negative plate eventually reaches a state where it can no longer be recharged. This failure to reconvert all the lead sulphate must be regarded as inevitable, regardless of how carefully the battery is charged. Sulphation of the plates and the loss of active material are the two prime causes of battery failure.

The capacity of a storage battery

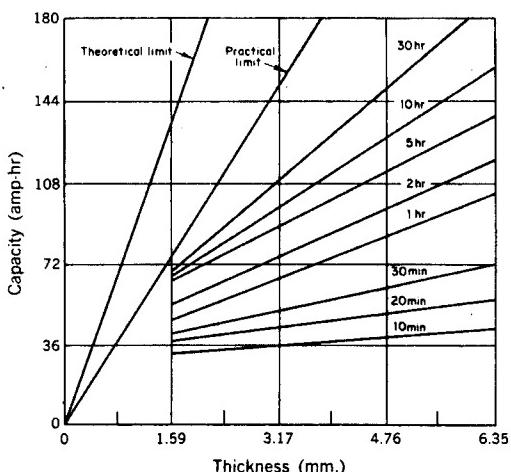


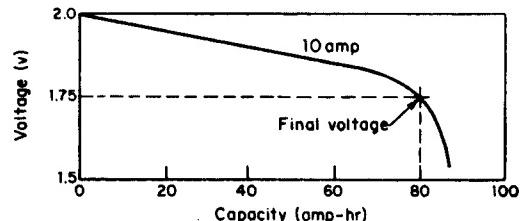
Figure 5. The relationship between plate thickness and battery capacity. Increased thickness is most beneficial at low discharge rates.

can be expressed either in ampere-hours or watt-hours. If the ampere-hour capacity is multiplied by the average voltage during discharge, the watt-hour capacity is obtained. Battery capacity most often is expressed in ampere-hours because it is simpler to measure than watt-hours. Nevertheless, given the ampere-hour capacity and the number of cells, the watt-hour capacity can be approximated quite easily because the nominal voltage of each lead-acid cell is two volts.

The ampere-hour capacity of a battery is not constant. It is greatest when

voltage characteristics of the cell during discharge. As the cell discharges, terminal voltage falls gradually from its open-circuit value. As the end of the discharge approaches, the loss in voltage is greatly accelerated. In figure 4, the rapid decrease in voltage begins at the knee of the curve, the point at which the cell is considered for practical purposes to be fully discharged. To discharge the cell beyond the knee of the curve would shorten its life.

Primary factors affecting capacity of storage battery cells are:



the discharge rate is low and least when it is high. In order to specify an ampere-hour capacity, therefore, it is necessary to indicate the number of hours over which the battery was discharged. This is known as the "hour-rate."

Automotive batteries customarily are classified at the 20-hour rate; motive power batteries at the six-hour rate; stationary batteries at the eight-hour rate. For example, a stationary battery with a capacity of 80AH, at the eight-hour rate, would be expected to deliver a discharge current of 10 amperes for eight hours. An automotive battery with a capacity of 100AH, at the 20-hour rate, would be expected to deliver a current of five amperes for 20 hours.

Because it is not practical to discharge a lead-acid battery to zero volts, capacity ratings are governed by the

- Amount of active material.
- Concentration of the electrolyte.
- Design of the plates.
- Porosity of the plates.
- Thickness and area of the plates.
- Rate of discharge.
- Temperature.

At low to moderate rates of discharge, the capacity of a storage battery cell increases with the thickness of active material on the plates. At high rates of discharge, the thickness has little effect because cell output then is practically a surface phenomenon. There is insufficient time for the electrolyte to diffuse into the pores of the plates, and the sulphate forming at the surface clogs the pores.

The difference between high and low discharge rates for plates of various thicknesses is shown in figure 5. For

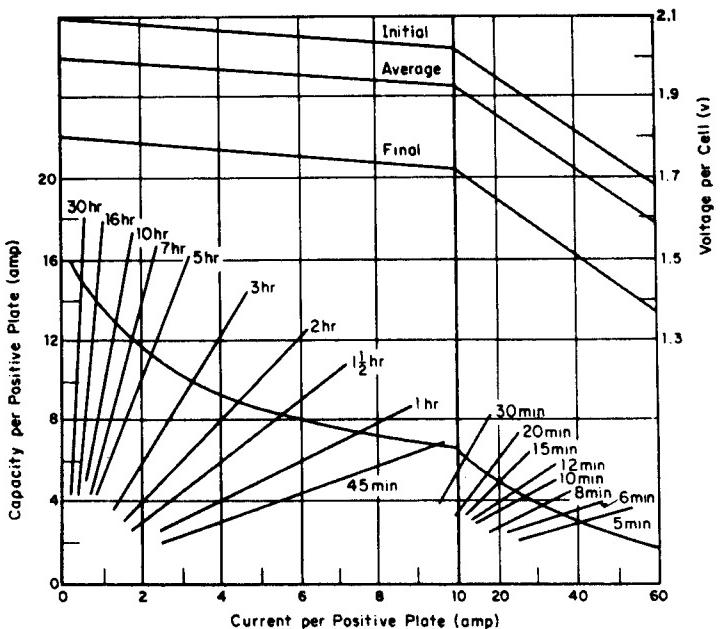


Figure 6. The capacity of a cell is inversely proportional to its discharge rate. Note that the scale is arbitrarily changed at 10 amps per plate to accommodate the complete characteristic.

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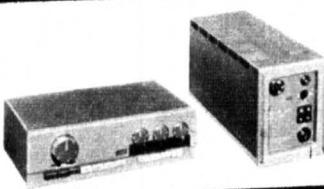
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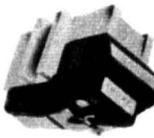
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example, a $\frac{1}{2}$ in plate at a 10-minute rate has only 38 per cent more capacity than a $\frac{1}{16}$ in plate. But, at the 30-hour rate, it has 170 per cent more capacity.

The capacity of a cell also depends upon the area of the plates. However, this is not the area simply calculated from the width and height dimensions. Rather, it is the true surface area exposed to the electrolyte. For example, the Manchester positive plate has seven to 10 times the surface area its height and width would indicate in figure 3. Each serrated pure-lead rosette and the surface of the grid become lead dioxide after formation. The area of tubular positive plates (figure 2) also is many times that of flat-plate batteries of comparable size.

The area of flat pasted plates is calculated from the width and height and doubled to provide for two sides. Typical outputs for flat plates of the same nominal size are listed below:

Plates	Area of pos. group	Capacity (AH/ per cell)	(AH)	sq. in.)
15	693 sq. in.	288	.329	
17	792 sq. in.	244	.307	
21	962 sq. in.	260	.270	

The capacities of cells are inversely proportional to their discharge rates (figure 6). To determine the capacity of a cell from this figure, the number of positive plates in the cell are multiplied by the rate or time of discharge desired. Note that in figure 6, the scale is changed arbitrarily at 10 amperes per plate so that the complete characteristics can be indicated in the single illustration.

At low temperatures, the resistance and viscosity of the electrolyte increase. As a result, the capacity of a storage battery decreases as shown in figure 7. Because these curves are for a battery rated at 11AH at 27.6°C (80°F), relative capacities can be read as percentages of the rated capacity. Although the curves represent data obtained from automotive batteries, which usually are rated at the 20-hour rate, they also indicate approximately what can be expected of other types of batteries.

There are three main areas of battery service: (1) Automotive (for starting, lighting and ignition). (2) Motive power (for industrial material-handling vehicles and mine tractors) and (3) Stationary (such as in switchgear control, telephone and microwave).

Automotive batteries are available in 12 and 6-volt sizes.

Two basic standards of performance for these starting, lighting and ignition batteries have been adopted by the Association of American Battery Manufacturers (A.A.B.M.), the Society of Automotive Engineers (S.A.E.) and the United States Government. These ratings are ampere-hours, at the 20-hour rate, and cold ratings at -17.8°C (0°F).

The ampere-hour rating indicates the lighting ability of the battery. A fully charged battery at 27.6°C (80°F) is discharged at a rate that is 1/20th of the 20-hour capacity in ampere-hours. For example, a 6-volt battery rated at 100 AH capacity would be discharged

at 5 amperes until a final voltage of 5.25 volts, or 1.75 volts per cell, is reached (figure 8).

Cold ratings indicate the engine cranking ability of fully charged batteries at low temperature. For cold ratings, 6 and 12-volt batteries of 80-AH capacity or more are discharged at 300 amperes, while 12-volt batteries of less than 80AH capacity are discharged at 150 amperes at a temperature of -17.8°C (0°F). The results can be expressed in either of two ways (figure 9):

1. By the terminal voltage of a fully charged battery five seconds after the start of a discharge at the indicated rate and with an initial electrolyte temperature of -17.8°C (0°F).
2. By the number of minutes required for the battery to reach a terminal voltage equivalent to 1.0 volt per cell when discharged at the indicated rates and with an initial electrolyte temperature of -17.8°C (0°F).

Automotive-type batteries have many marine and aircraft applications. Those used in small boats are quite similar to automobile batteries. Aircraft batteries are quite similar, too, but they are designed for maximum power output in minimum space. Special arrangements are made to make them capable of functioning in any attitude without spilling electrolyte.

Batteries for supplying motive power are made in a wide variety of configurations. Thus, they fit into variously designed compartments of material-handling and mining vehicles. Single cells are placed in rubber jars, and the necessary number of cells are assembled in steel trays to make up motive power batteries. Because they are subjected to deep discharges and high-cycle service, their plates are much thicker than those of automotive-type

batteries and have greater surface area exposed to electrolyte.

The main causes of failure of motive power batteries are positive-grid corrosion and loss of positive active material. To retard corrosion, the positive grids of high-quality flat and tubular types are cast of silver-lead alloys. To retard loss of positive active material in flat-plate motive power batteries, the positive plates are wrapped with multiple layers of fibre glass mats, polystyrene boots are slipped on the bottom of the plates and the plates are inserted in perforated plastic sleeves (figure 10).

Woven tubing is used to retard loss of active material in tubular-type batteries. The tubular-type battery has, for many years, been highly popular not only for motive power but also for other applications, because of its long life and deep discharge characteristics. The smallest sizes are used for miners' cap lamps and for golf cars. The same size battery compartment of a golf car can house a tubular-type battery with up to 30 per cent more electrical capacity than an automotive battery of the same physical size.

Industrial applications for tubular positive-plate batteries range from small walkie-type material handling vehicles to huge rider-type fork trucks capable of lifting railroad boxcars. Battery-powered industrial trucks are popular because they give off no fumes to add to air pollution. Although the initial cost of an electric truck (with battery and charging equipment) is comparatively high, its low maintenance, long life and low operating expense make it more economical than a combustion-engine vehicle in the same service.

Stationary batteries, which are not moved about as are batteries in automotive or motive power service, usually are mounted on steel racks or in boxes in electric utility plants, tele-

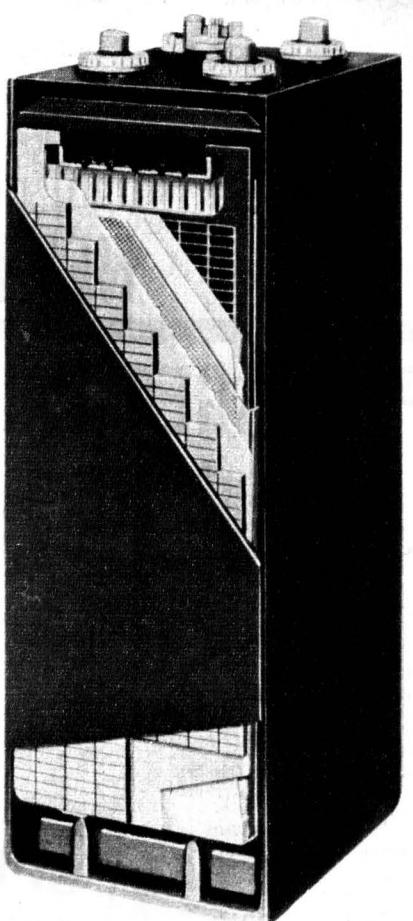


Figure 10. Cutaway photo showing components of a flat plate type lead-acid cell for motive power service. Tubular type batteries (figure 2) are becoming increasingly popular in motive power applications.

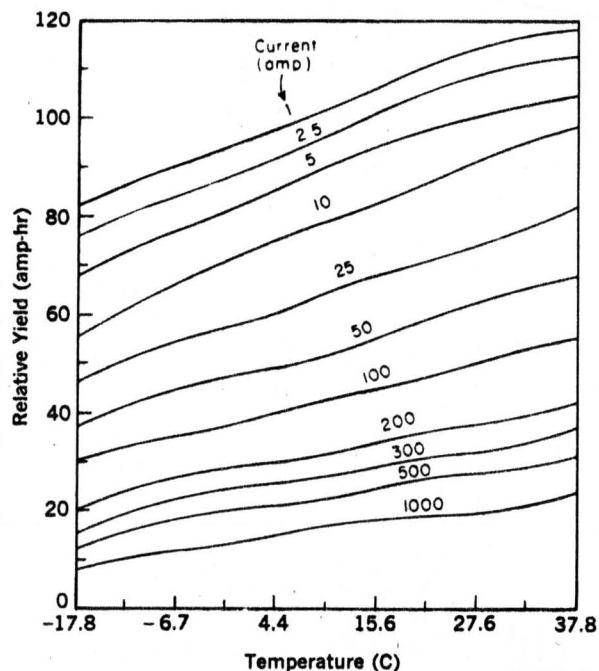


Figure 7. Effect of temperature on capacity of a lead-acid battery rated at 100AH (20 hour rate) at 27.6°C . Note that at 5A the capacity falls from 100AH at 27.6°C to less than 70AH at 17.8°C .

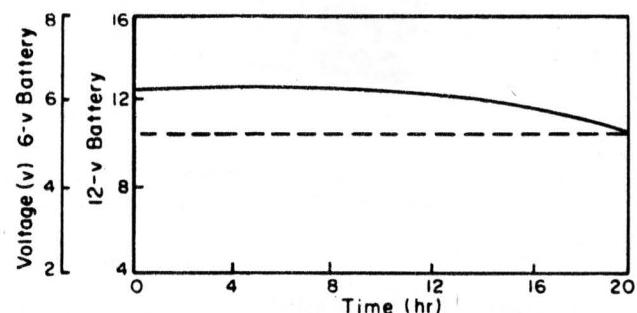


Figure 8. Typical AABM discharge curve at the 20 hour rate at 27.6°C . Final voltage for a 6V battery is 5.25; for 12V battery, 10.5 (1.75V per cell).

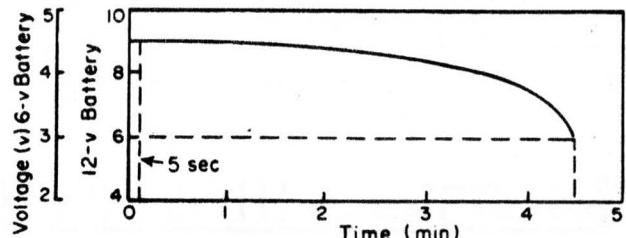
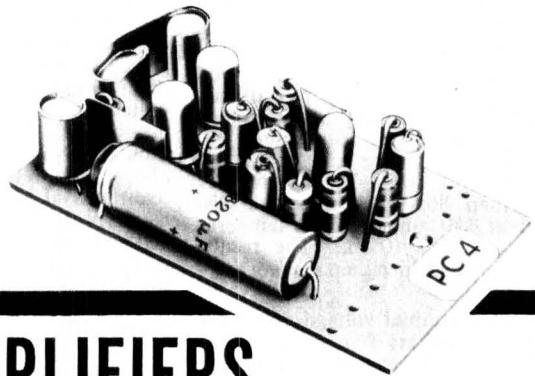


Figure 9. Typical AABM cold rating at -17°C for discharge of 300A for 6V batteries and 150A for 12V batteries of less than 80AH capacity. The rating depends on the time required to reach 1V per cell.

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fiers.

plifiers.

em Amplifier.

nplifier.

ercomm (Portaphone).

Power Amplifier.

Intercomm Amplifier.

ment Amplifier.

fier.

Transmitter Modulators.

dio Amplifier.

er Amplifier.

Back Amplifier.

ent Amplifier.

mplifiers.

fiers.

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em Amplifier.

nplifier.

ercomm (Portaphone).

specification details

A typical miniature Audio-Amplifier is illustrated actual size overleaf. Circuits are of transformerless, complementary symmetry type, operating off Standard Voltages. Can be wire-in or plug-in as required.

PERFORMANCE DATA	PC1	PC2	PC3	PC4	PC5	PC7	PC9
Power Output mW	150	400	400	400	3W	800	Pre-amp
Input Sensitivity mV	50	1	5	150	5	5	1V
Input Impedance ohms	1.5K	1K	2.5K	220K	1.5K	1.5K	1M
Output Impedance ohms	40	15	15	15	3	8	600
Supply Voltage-volts	9	9	9	9	12	9	9
Typical distortion %	2	3	3	3	3	3	1
Frequency response	300-15K	200-12K	200-12K	200-12K	50-12K	50-12K	20-20K
Overall Dimensions	All 3/4 in. high	2 x 1	2 1/2 x 1 1/2	2 1/2 x 1 1/2	5 1/2 x 1 3/4	3 x 1 3/4	2 x 1

tecnico ELECTRONICS PTY. LTD.

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SYDNEY: General Accessories Limited,
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MELBOURNE: Radio Parts Pty. Limited,

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Limited, 220 Park Street 3000. **BRIS-**

BANE: General Accessories Pty. Limited,

50 Little Edward Street 4000. **ADELAIDE:**

General Accessories Pty. Limited, 81

Flinders Street 5000. **PERTH:** General

Accessories Pty. Limited, 46 Milligan

Street 6000.

phone exchanges, railway signal locations and in various types of buildings. Stationary batteries usually are used to provide emergency power when normal power fluctuates or fails.

Construction of stationary batteries is slightly different from other types, but many of the better features of other types are incorporated in them. A major consideration in stationary batteries is long life as opposed to space and weight. Thicker plates are used. The volume of electrolyte is greater. Specific gravity is less. Long life can be expected because most stationary batteries operate under favourable conditions. Temperatures usually are less than 27.6°C. (80°F.), and the charging system continuously supplies approximately 2.15 volts per cell to the battery.

This low rate of charge — often called a "float" charge — is adequate to maintain a battery in a fully charged condition. The low rate of charge assures a minimum of grid corrosion, low water consumption and low operating temperatures. Loss of active material is minimal because there are relatively few discharges. The main cause of failure is positive-grid corrosion because the positive is converted almost continuously to lead dioxide. Thus, positive grids of many stationary batteries are cast of lead-silver or lead-calcium alloys to deter this corrosion.

Manchester-type stationary batteries (figure 12) are among the longest-lived batteries in the world. This is attributed to their lack of plate growth or swelling.

Flat-plate stationary batteries are available in a wide variety of sizes. Electrical capacities range from 10 to 7000AH. Their grids are made of either antimony or calcium alloys. Most stationary batteries now are provided in clear plastic containers, but there are many installations where older batteries in rubber and glass jars still are in service.

Recently, stationary batteries have been developed with tubular-type positive plates, similar to those in motive power batteries. One of the first experimental batteries of this type was taken out of service after 16 years at a major eastern-United States utility company. It still had 100 per cent of its rated capacity in all cells. The positive-grid spines, made of lead-silver alloy, had very little corrosion.

A new cell of this type, using a square configuration for its positive-



Figure 11. An example of the large size lead-acid cells used in telephone exchanges and submarines.

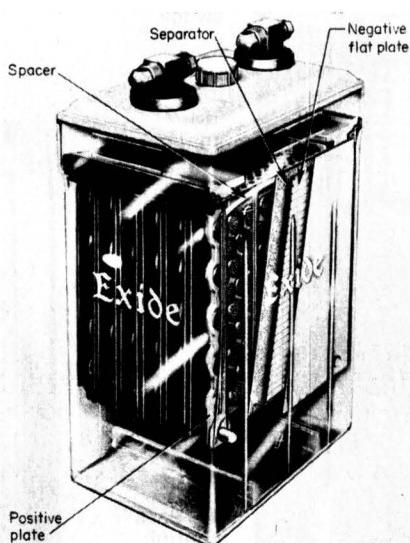


Figure 12. A lead-acid cell designed for stationary service and using Manchester positive plates.

plate tubes, saves more than 50 per cent in floor space, weighs 40 per cent less and is 70 per cent more efficient than flat-plate cells of comparable rating. Batteries of this type recently have begun to be used to supply critical emergency power via DC-to-AC static inverters, notably in electrical utility and chemical processing plants.

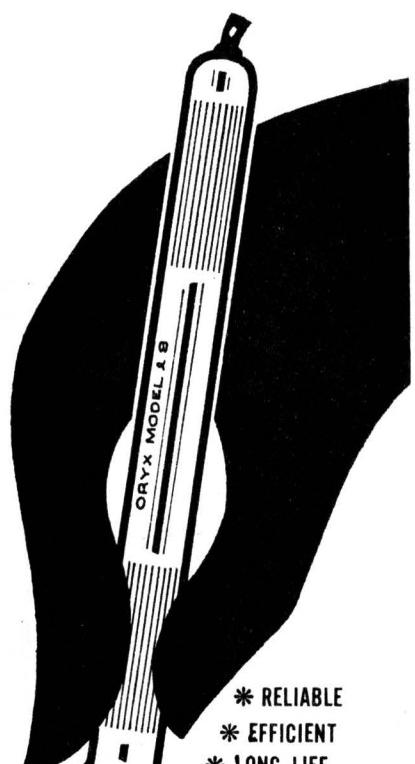
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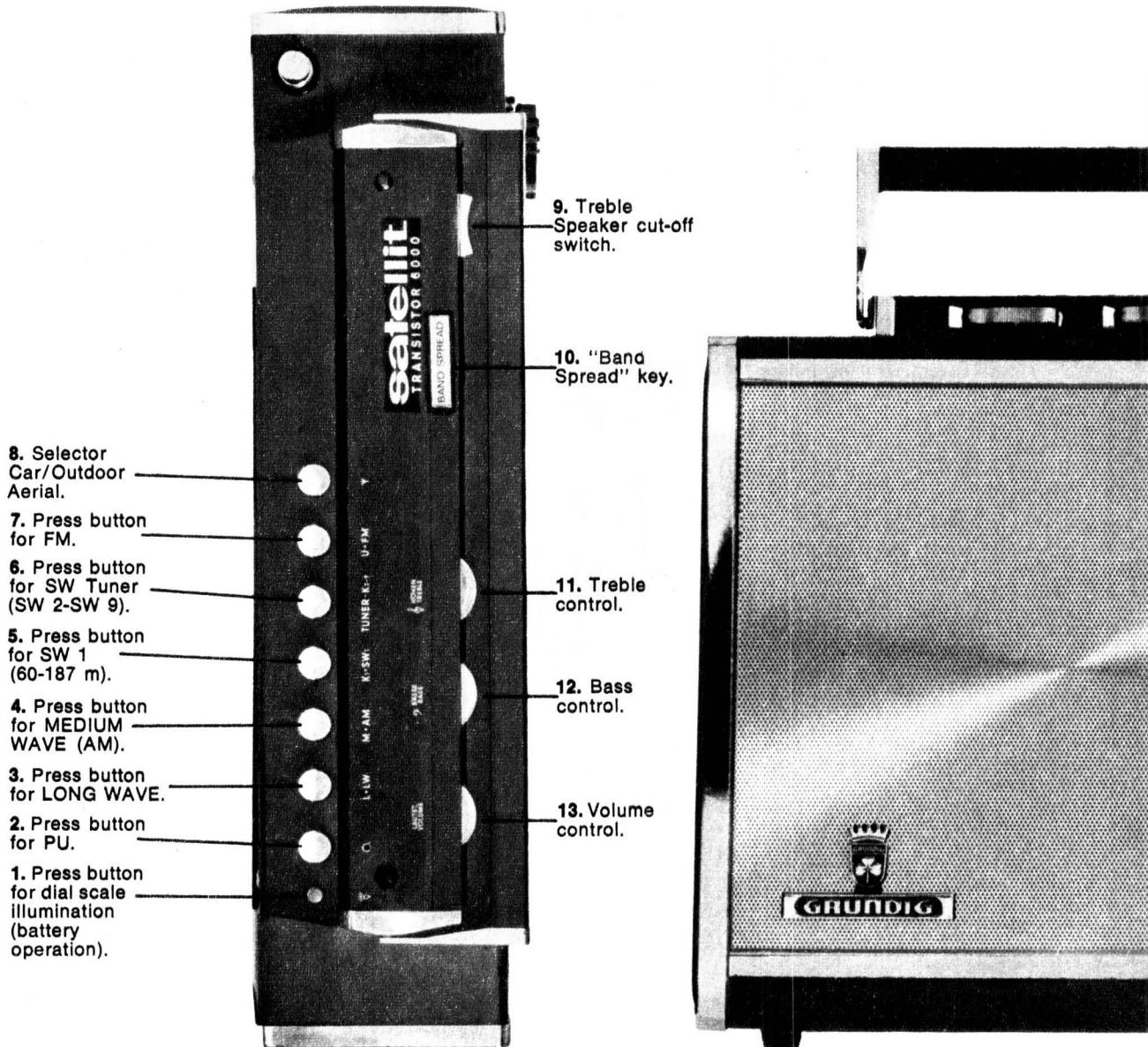
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The new GRUNDIG TR6000 is no set for just everyone. Its technical brilliance, extraordinary ease of operation and its sturdy, fascinating looks will satisfy the most meticulous radio enthusiast.

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8. Selector
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Aerial.

7. Press button
for FM.

6. Press button
for SW Tuner
(SW 2-SW 9).

5. Press button
for SW 1
(60-187 m.).

4. Press button
for MEDIUM
WAVE (AM).

3. Press button
for LONG WAVE.

2. Press button
for PU.

1. Press button
for dial scale
illumination
(battery
operation).

9. Treble
Speaker cut-off
switch.

10. "Band
Spread" key.

11. Treble
control.

12. Bass
control.

13. Volume
control.

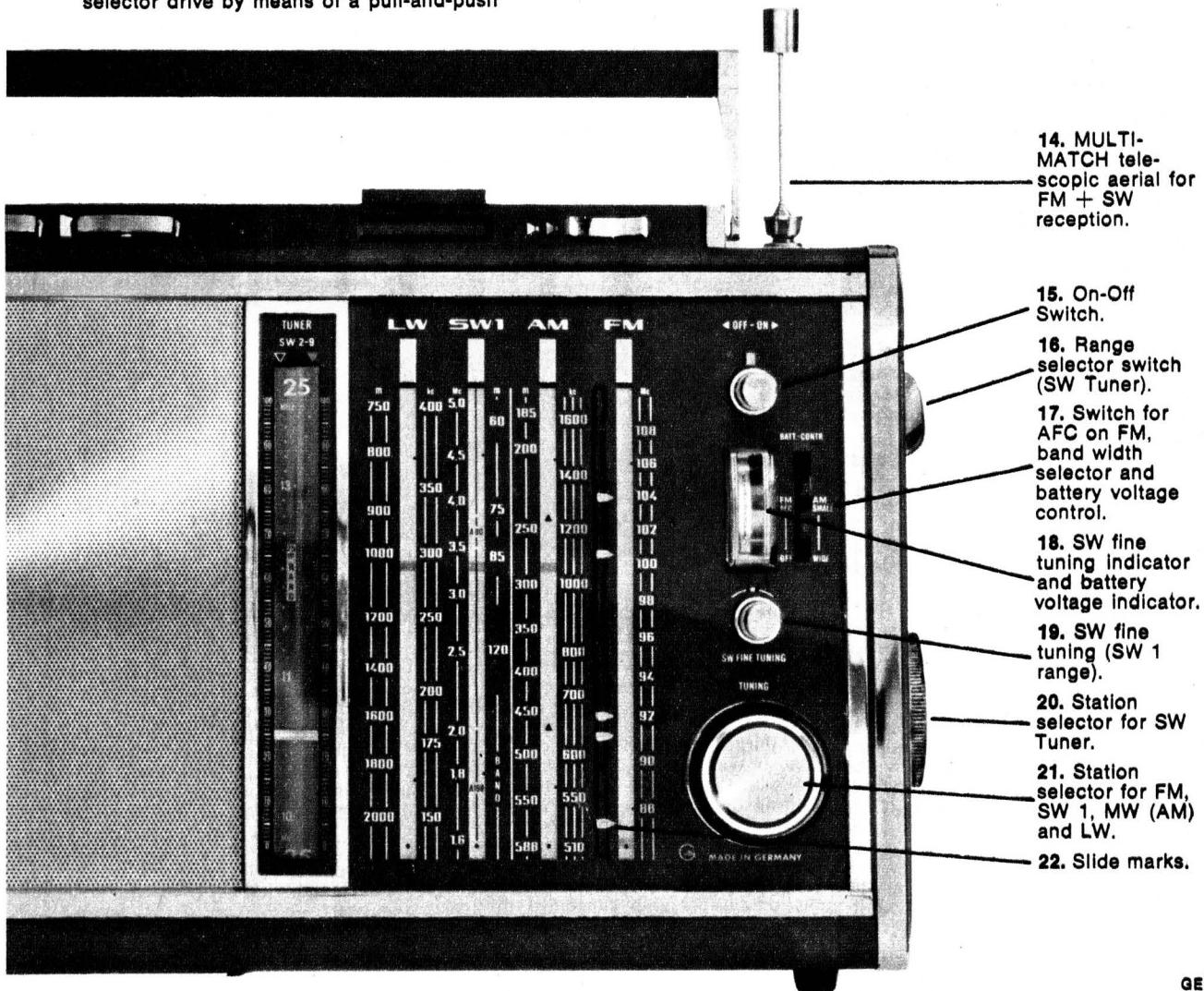
GRUNDIG

Transistor 6000

Technical Specifications:

20 tuning ranges: FM, 17 x SW (SW 1: 60-187 m, SW 2: 42-60 m and 49 m band, SW 3: 36-50 m and 41 m band, SW 4: 26,5-37 m and 31 m band, SW 5: 21,5-30 m and 25 m band, SW 6: 16,5-24 m and 19 m band, SW 7: 14-20 m and 16 m band, SW 8: 12-16,7 m and 13 m band, SW 9: 10-14 m and 11 m band), Medium Wave (AM) and Long Wave • circuits: FM 14 (3 can be tuned), AM (without SW Tuner) 9 (3 can be tuned); SW Tuner 14 (3 can be tuned) • 19 + 1 transistors (17 of these are silicon trans) • best possible cross modulation by field effect transistors • 14 + 2 diodes • tuned-in first stage on all ranges • double superimposition of SW Tuner with 4-circuit band filter • gain control: AM 3-stage, SW Tuner 3-stage with additional control, FM 1-stage • ferrite aerial for MW (AM) and LW; MULTI-MATCH telescopic aerial for FM and SW (switchable) • DUPLEX Single Selector tuning • separate SW rotating drum selector drive by means of a pull-and-push

tuning knob • colour marks for station tracing • SW fine tuning for SW 1 • "Band Spread" key • switchable AFC on FM • AM band width selector switch • tuning indicator (S-meter) • battery voltage indicator • 2 Superphone speakers (treble speaker can be switched off) • bass and treble control • 2 Watts push-pull output stage • battery operation by 6 x 1,5 V mono cells • built-in mains power pack TN 12 • dial scale illuminated • sockets for external power supply, earphone, external speaker, outdoor aerial, car aerial, outdoor dipole antenna, ground, record player/tape recorder • receptacles for SSB device with switch-over to manual control, sound filter, product demodulator • cabinet: wood, w/leatherette covering, in black and walnut.
Size approx. 44 x 26 x 12 cm
(= 18½" x 10¼" x 5")
Weight (incl. power pack), approx. 6.1 kg
(w/out batt.)



EASY ON THE EAR — AND ON THE POCKET!

THE 3-PLUS-3 STEREO AMPLIFIER

By Leo Simpson

For a modest outlay and an equally modest constructional effort, it is possible to build a small, modern solid-state audio amplifier. It can provide a starting point for the would-be audio enthusiast, plus a lot of listening pleasure.

This design is intended to fill the demand for a simple, low-powered stereo amplifier. It can be driven to full power by the popular ceramic or crystal cartridges and will produce adequate sound level in a domestic lounge room for ordinary family listening.

The amplifier can typically be used with 8, 10 or 12-inch loudspeakers of 8 or 15 ohms impedance and preferably of high sensitivity. Where space is a problem, it can be fed into a pair of Playmaster "Bookshelf" or "Point-Four" systems, a pair of Mullard "Mini" systems, or one or other of the commercial equivalents. It is NOT suitable for use with some very small compact enclosures with notably low sensitivity. This is a question which can well be discussed with your supply house.

Power output on music signal is approximately 3 watts per channel, being of a similar order to ordinary commercial stereograms and mains-operated stereo players. This order of power, together with the necessary high input impedance and overall gain is obtained with only four transistors per channel.

Of the four transistors, two are silicon types used for the voltage amplifier and driver stages, and two are germanium types serving as the output pair.

The input transistor is a low-noise silicon NPN type functioning as a common emitter amplifier. Positive current feedback applied from the emitter to base (bootstrapping) increases the effective input impedance of the stage.

Negative AC feedback and negative DC feedback is applied from the junction of the two output transistor emitter resistors to the emitter of the input transistor. The capacitor across the 22K feedback resistor rolls off the extreme high frequency response in the interests of stability. Low frequency response is determined mainly by the 10uF capacitor completing the feedback loop to earth and the 400uF output coupling capacitor to the loudspeaker.

Because all stages in the amplifier are direct coupled, the voltage at the junction of the output transistor emitter resistors is determined by the ratio of the 470K to the sum of the 150K and 270K resistors—the bias network for the input base. Normally, there

should be no need to adjust this network but the optimum setting, for those with a signal source and oscilloscope to hand, is for symmetrical clipping at the onset of overload.

Following the input transistor is a silicon PNP transistor which performs further voltage amplification and also acts as the driver for the output transistors. The output transistors are a complementary germanium pair, AC187/AC188 in a push-pull complementary-symmetry mode. Complementary-symmetry operation has the advantage of achieving the phase splitting necessary for class-B push-pull operation in the output pair itself. For those not familiar with this principle a short explanation follows:

Suppose, initially, that the signal from the collector of the driver transis-

Specifications

Power: 3 watts music power per channel into 8-ohm loads; 2.5 watts music power per channel into 16-ohm loads. 2 watts RMS (continuous tone) into 8 or 16-ohms loads with either channel driven singly.

Distortion: 1.5% THD at 2KHz at 2.5 watts into 16-ohm load; 2% THD at 1 KHz at 2.5 watts into 8-ohm load.

Signal-to-noise ratio: 54dB with respect to 2.5 watts.

Crosstalk: -38dB at 1KHz with respect to 2.5 watts; -30dB at 10 KHz with respect to 2.5 watts.

Frequency response at 1 watt: -3dB points at 25Hz and 15KHz.

Tone Control: -17dB cut at 10KHz.

Input Sensitivity: 420mV for full power for all inputs; input impedance 1 megohm. (See text).



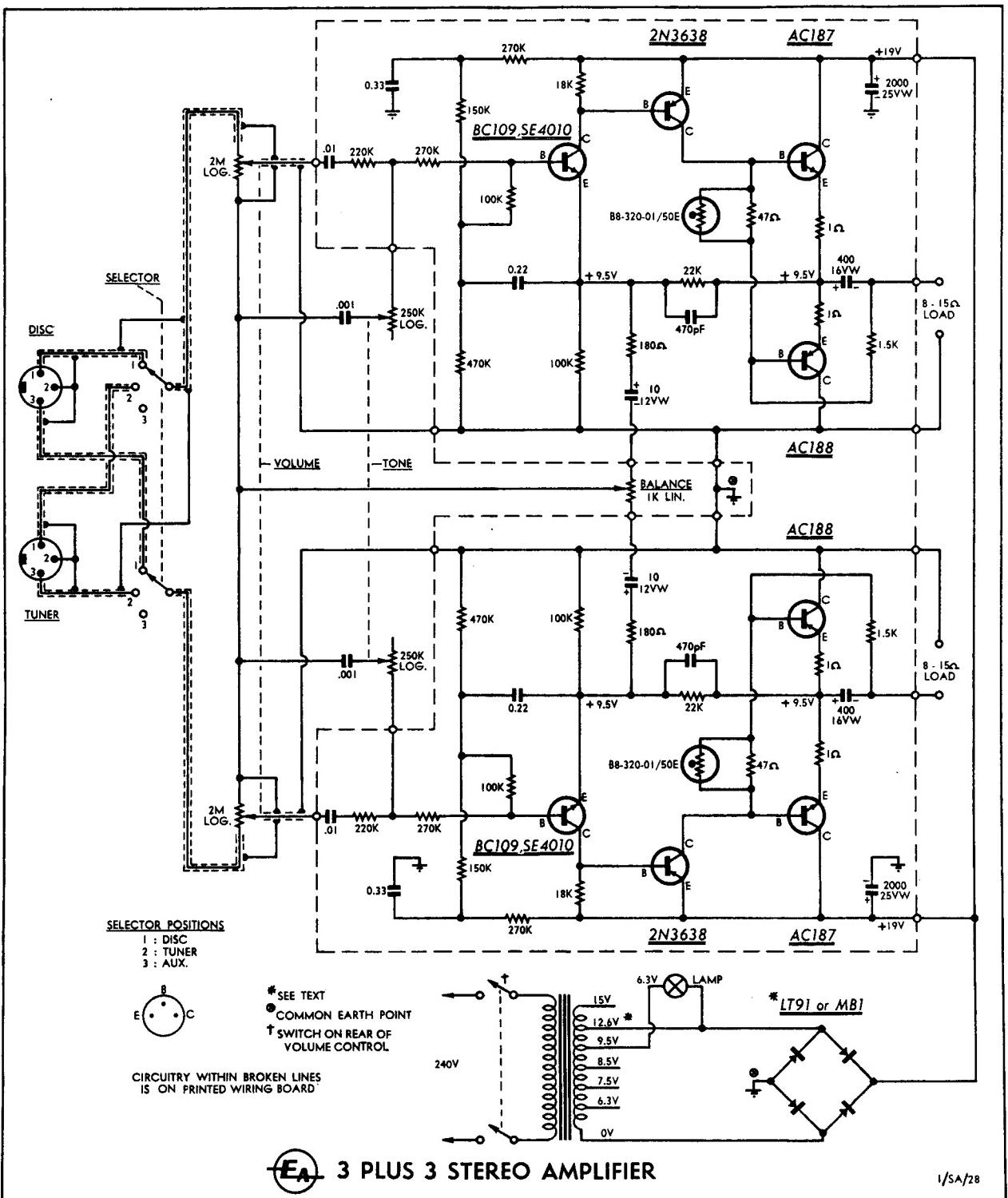
The prototype amplifier with its wood-grained metal cover and, on the next page, the complete circuit diagram showing both channels.

tor is positive-going, so that both output transistor bases are driven positive. This will cause the upper (NPN) transistor to conduct and to "charge up" the output coupling capacitor via the loudspeaker load, the lower (PNP) transistor meanwhile being turned off. During the following half-cycle, as the signal becomes negative with respect to the junction of the two emitters, the upper transistor turns off while the lower one conducts and discharges the output coupling capacitor through the loudspeaker load.

Class-B operation is thus achieved, with positive half-cycles being supplied to the loudspeaker from the positive

supply rail, the negative half-cycle being supplied by the subsequent discharge of the coupling capacitor.

A frequent type of distortion encountered in a class-B amplifier is "cross-over," i.e., distortion introduced at the cross-over point where one transistor turns off and the other begins conducting. This distortion can be reduced to negligible proportions by a suitable choice of "quiescent" current for the output pair—the current under "no-signal" conditions. A suitable choice of quiescent current ensures a small overlap and a smooth transition between the states of conduction and non-conduction in each transistor.



In this case, the lower transistor is slightly forward-biased by the divider formed by the 1.5K and 47 ohm resistors. The quiescent current should be 8 to 10mA and can be set by varying the 47 ohm resistor. Adding a small resistor in series will increase the quiescent current; shunting the 47-ohm resistor will decrease the current.

Temperature stabilisation, i.e. stabilisation of the quiescent current to prevent thermal runaway and possible destruction of the output transistors is provided, firstly, by the 1 ohm emitter resistors. These provide negative current feedback and also tend to "swamp" internal resistances of the

transistors, which are temperature sensitive. The thermistor provides further stabilisation; an increase in the base current of the lower transistor (AC188) will cause the thermistor to decrease its resistance and thus bias the transistor back into a lower state of conduction.

Referring now to the control circuitry it can be seen that each channel input is connected across a 2-megohm volume control. The volume control wiper is connected to the input base via 220K and 270K resistors, with their junction connecting to a treble-cut control. Besides increasing the input impedance, the resistors satisfy

another basic requirement. In a direct coupled configuration of this kind, connecting the input transistor base to earth, via a capacitor, may cause low frequency instability. These two resistors inhibit any such tendency.

The selector switch will accommodate three different inputs although, in the interests of simplicity, only two sockets are provided at the rear of the amplifier. If necessary, access to the third position can be provided by a flying lead.

Also in the interests of simplicity, no attempt has been made to provide stereo/mono switching. Paralleling the inputs can sometimes reduce back-

Taylor Model 127A

pocket-sized 20,000 ohms per volt Multimeter



The instrument utilizes a sturdy moving-coil centre-pole meter developed by Taylor Electrical Instruments and can stand a momentary overload up to 10,000%.

- **VOLTAGE DC:** 0.3V to 1,000V in 7 ranges
- **VOLTAGE AC:** 10V to 1,000V in 5 ranges
- **CURRENT DC***: 50 μ A to 100 mA in 4 ranges
- **RESISTANCE:** 0-20 mW in 3 ranges having centre scale calibrations of 20 ohms, 20,000 ohms and 200,000 ohms.
- **ACCURACY:**

DC ranges — 3% f.s.d.
AC ranges — 4% f.s.d.

Optional Accessories:

Leather carrying case with shoulder strap
High voltage probe
AC adaptor

*External DC shunts to extend the DC current ranges over 1A, 5A, 10A f.s.d.

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ground noise from old mono records by cancellation of the vertical component. However, with reasonably kept records, it is not a vital consideration and most listeners tend nowadays to play all records straight through a stereo system, whether the records themselves are stereo or mono.

No attempt has been made to provide this amplifier with the separate bass and treble boost and cut controls frequently seen on more elaborate amplifier systems. Such control facilities add considerably to the cost and complexity of an amplifier and are inconsistent with the concept of an inexpensive easy-to-build unit.

Another very practical reason is that a 3-watt amplifier does not have power to spare to cope with boosted output, particularly at the bass end. While it could admittedly be operated at low level with boosted bass and treble, the strong temptation is to turn it to near maximum volume — and then turn up the bass boost—leading to severe distortion.

The tone control specified is a conventional treble-cut arrangement.

The balance control takes the form of a 1K (linear curve) potentiometer which varies the feedback of each amplifier. In this form it avoids shunting of the input circuit, but it does have the somewhat academic disadvantage that it will not completely "cut-off" either channel. However, it has a range of about 5dB either way, which is ample to cope with any likely degree of unbalance. The balance control can most easily be set by playing a mono record and setting the control for equal output from the channels.

The design of class-B transistor stereo amplifiers commonly calls for a regulated power supply because of the large range in current drawn—typically from about 20mA at "no signal" to 600mA at full power into 8-ohm loads. A more economical approach is to make the best of the inherent regulation of the power transformer and to specify a large reservoir capacitor which will supply the large peak currents for the brief periods that they are normally required for typical music and speech reproduction. An important requirement is that the supply voltage must not rise above a certain value under quiescent conditions, otherwise the collector-emitter rating and/or power dissipation rating of the output transistors may be exceeded.

The use of a large reservoir capacitor has the advantage that it gives the power supply a very low AC output impedance which is desirable to preserve good separation between channels. This is not always the case with regulated power supplies which might have large effective capacitance, as far as ripple filtering is concerned, but a relatively high impedance looking back from the amplifier.

The power supply uses a multi-tapped transformer with, among others, taps at 12.6 and 15 volts, 1 amp. One of these two taps feeds a full wave bridge rectifier which feeds a 2000uF/25VW electrolytic capacitor in each channel. Decoupling between the channels did not prove to be necessary and extra resistance would have detracted from regulation. The quiescent power supply voltage must not exceed

19 volts if the amplifier is to be used with 8-ohm loads and 21 volts if it is to be used with 16-ohm loads.

DETAILS OF PERFORMANCE: The performance of this little unit is well on a par with the amplifiers used in commercial "stereograms" and in some respects is well above average.

With a 21-volt supply the amplifier will deliver 2.5 watts music power into 16-ohm loads. Harmonic distortion was measured at 1.5% at 1KHz. With a 19-volt rail the power delivered to 8-ohm loads is 2.5 watts music power at 2% harmonic distortion, and 3 watts at 3.5% harmonic distortion at 1KHz. These music power ratings are obtainable only with an external regulated power supply or with a tone burst tester as described in "Electronics Australia" for April, 1968.

Signal-to-noise ratio was measured as -54dB with respect to 2.5 watts. This is the ratio of residual noise to 2.5 watts, obtained with volume and tone controls at full gain (fully clockwise) and the balance control centred (for equal gain in both channels) and with open-circuit input. The residual noise consisted mainly of low frequency transistor noise and was reduced at lower settings of the volume control. This means that the amplifier is very quiet, and at full gain one had to listen close to the speakers to detect any noise even with high-sensitivity speakers.

Separation between channels was measured as -38dB with respect to 2.5 watts at 1KHz and as -30dB with respect to 2.5 watts at 10KHz. This was measured with one channel driven to full power at the same control settings as above and with open-circuit input for the idle channel.

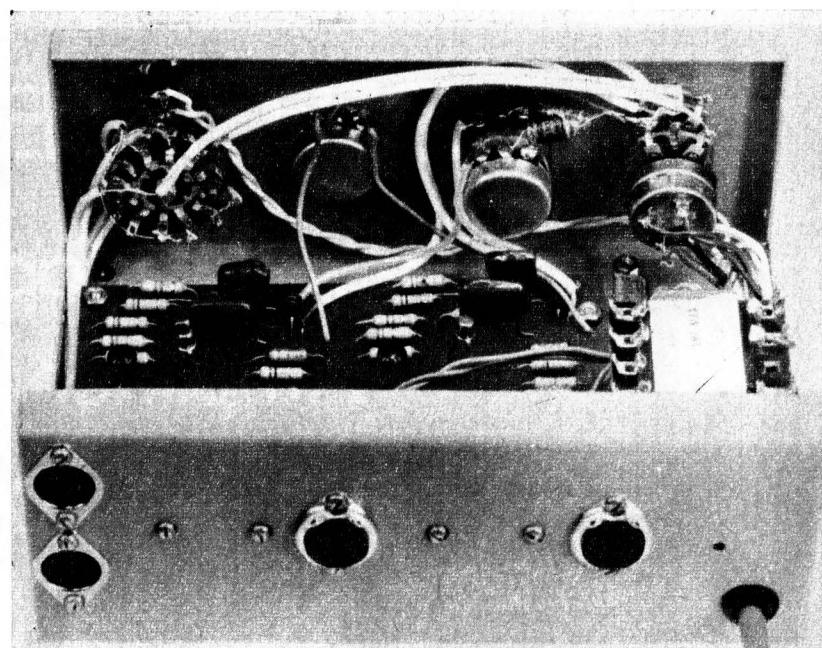
Measured at an output of 1 watt, the response is level over the major portion of the audible range, tapering to -3dB points at 25Hz and 15KHz.

Input required for full output is about 420mV. To ensure adequate level from lightly recorded tracks, it is best to use the amplifier with a stereo crystal cartridge or one of the ceramic cartridges having reasonably high signal output. The Decca Deram and the Connoisseur which are in the lower output group will produce some very pleasant sound but may not drive the amplifier to full output on lightly recorded tracks.

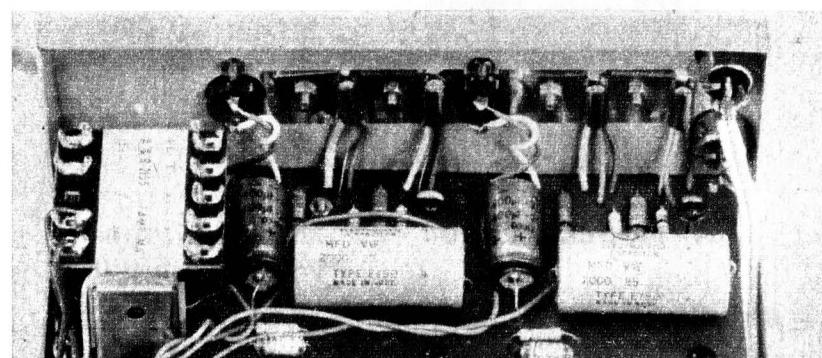
Apart from being used with loudspeakers, the amplifier is suitable for use with low impedance stereo headphones. High impedance headphones may also be used but the amplifier should be terminated with a suitable resistive load in parallel with the headphones, e.g., 33 ohms. Disconnecting the load while power is applied to the amplifier will not cause any damage but short-circuiting the outputs may ruin the output transistors.

CONSTRUCTION: The amplifier is assembled in a chassis with overall dimensions of 7 $\frac{1}{2}$ x 5 $\frac{1}{2}$ x 3 inches. It is U-shaped, with a $\frac{1}{2}$ -inch flange all round. The prototype was made of 18-gauge aluminium. If steel is substituted and/or the chassis is painted, the area to which the transistors' flag heat-sinks are bolted must be bare metal, to ensure good heat transfer.

The majority of components, including the reservoir and output coupling capacitors, are mounted on a printed wiring board containing the circuitry for two channels. The ex-



Above: The rear view shows the controls, the front portion of the printed wiring board, and the input and output sockets on the rear face. Below: The amplifier viewed from the front.



PARTS LIST

- 1 chassis with overall dimensions, 7 $\frac{1}{2}$ x 5 $\frac{1}{2}$ x 3in.
- 1 metal cover with dimensions to suit chassis (optional).
- 1 front panel.
- 1 power transformer, with multi-tapped secondary, 1 amp. (A&R 2155).
- 2 3-pin DIN sockets.
- 2 2-pin polarised sockets.
- 1 printed board, 68/a8.
- 1 3-pole 3-position rotary switch.

SEMICONDUCTORS

- 2 AC187/188 complementary matched pairs (with flag heat sinks).
- 2 BC109, SE4010 or similar low-noise, silicon NPN type.
- 2 2N3638 silicon PNP.
- 1 LT91 selenium bridge rectifier or MBI silicon bridge rectifier.
- 2 B8-320-01A/50E thermistors.

POTENTIOMETERS

- 1 x 2M (log) dual ganged, with rotary power switch.
- 1 x 250K (log) dual ganged.
- 1 x 1K (lin.).

RESISTORS

- ($\frac{1}{2}$ or $\frac{1}{4}$ watt, 5 p.c. tolerance)
- 2 470K, 4 x 270K, 2 x 220K, 2 x 150K, 4 x 100K, 2 x 22K, 2 x 18K, 2 x 1.5K, 2 x 470 ohm.

($\frac{1}{2}$ watt, 5 p.c. tolerance)

- 2 x 47 ohm, 4 x 1 ohm, wire-wound.

CAPACITORS

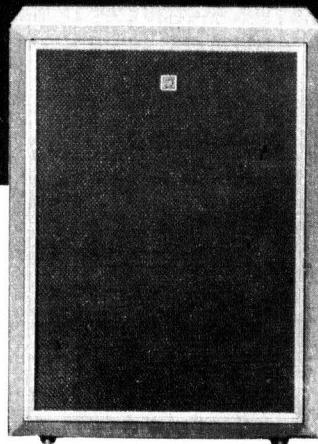
- 2 x 2000uF/25VW pigtail electrolytic.
- 2 x 400uF/16VW electrolytic.
- 2 x 10uF/16VW electrolytic.
- 2 x 0.33uF/L.V. (low voltage) metallised polyester.
- 2 x 0.22uF/L.V. metallised polyester.
- 2 x 0.01uF/L.V. polyester or metallised polyester.
- 2 x .001uF/L.V. polyester, polystyrene, or ceramic.
- 2 x 470pF/L.V. polyester, polystyrene, or ceramic.

SUNDRIES

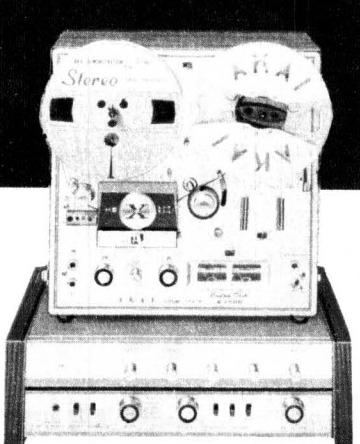
- 4 turned aluminium knobs. 4 $\frac{1}{2}$ in spacers 1/8in clearance.
- 4 rubber feet, 1 miniature 3-pin tag-strip, mains cord and plug, mains cord clamp, grommet, lamp and miniature bezel, dual shielded cable, hook-up wire, spaghetti sleeving, screws, nuts, solder, etc.

A PERFECT SET-UP!

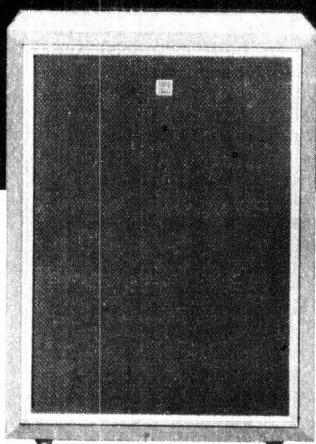
Combine Akai's Tape Deck, Amplifier and Speaker System



MODEL SW-130



**MODEL X-150D
MODEL AA-5000**

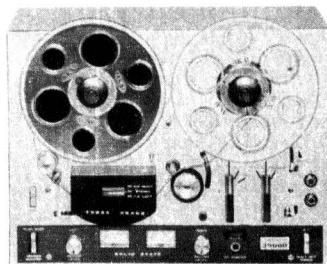


MODEL SW-130

FEATURES:

- *4-track stereo/monaural recording and playback.
- *4-speeds (15 ips optional) *3 heads.
- *2 speed hysteresis synchronous motor
- *Cross-Field frequency response—30 to 23,000 cps.
- *Signal to noise ratio—better than 50 db
- *Solid-State pre-amplifier

- *Automatic shut off, Instant stop lever
- *DIN jack, Stereo headphone jack
- *Tape cleaner *Oil finished wooden cabinet
- *Universal voltage selector (100 to 240V, 50/60 cycles)
- *AA-5000 and SW-130 can be matched with this deck



MODEL 3000

FEATURES:

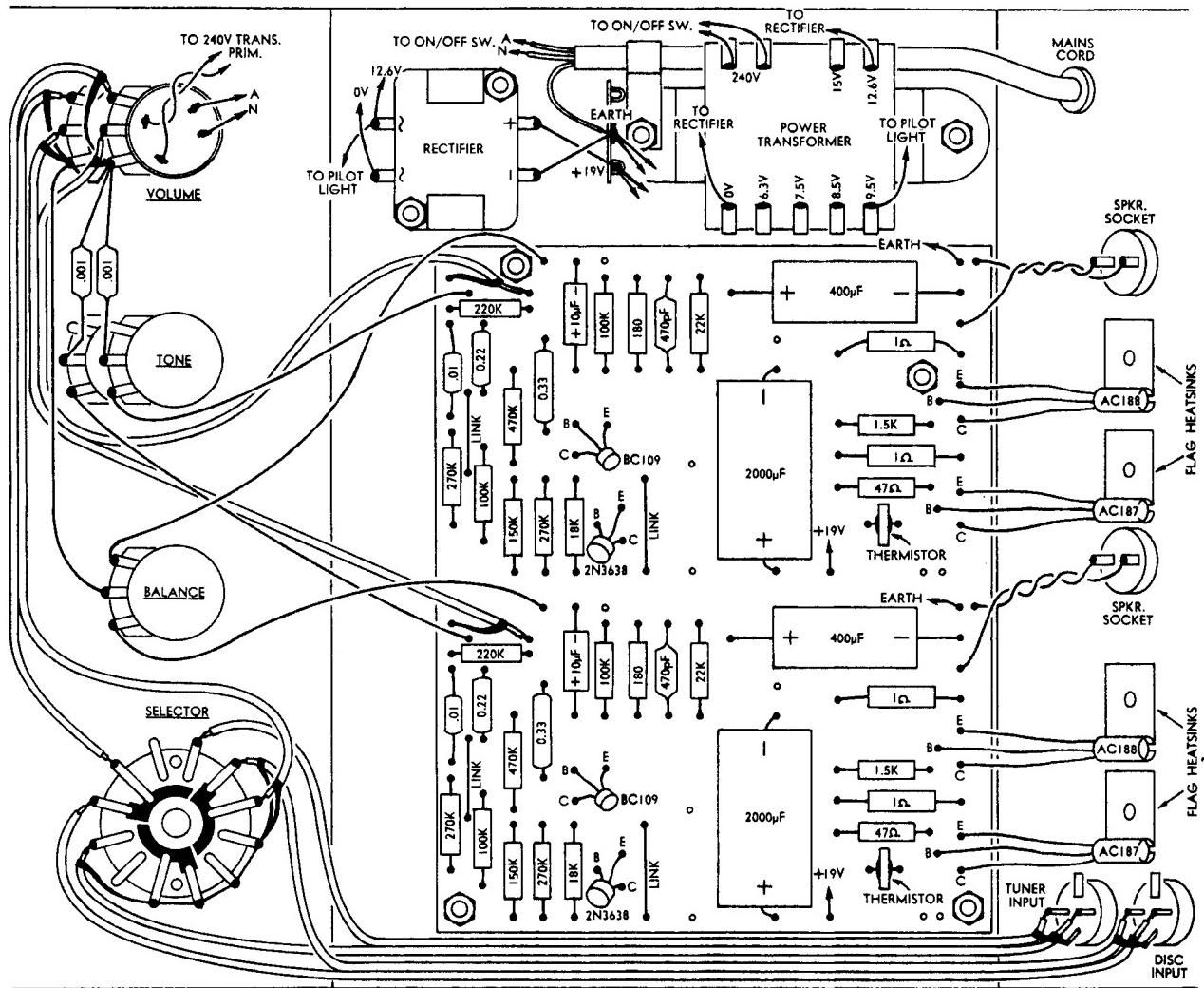
- *4-track stereo/monaural recording and playback.
- *2 speeds *3 heads
- *All silicon transistor pre-amplifier
- *Automatic shut off, Instant stop control
- *Tape cleaner

- *Equalizer for each tape speed
- *DIN jack
- *Stereo headphone jack
- *Beautifully grained wooden cabinet
- *Universal voltage selector (100 to 240V, 50/60 cycles)

AKAI

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With the aid of the pictures and this wiring diagram, constructional problems should be minimised.

ceptions are the potentiometers and selector switch and the .001uF capacitor associated with the tone controls.

Two identical wiring patterns are contained on the board which may be cut in two if only one amplifier is required. When the pattern was laid out it was made adaptable to a higher powered amplifier circuit—hence the need for a couple of jumper wires.

The output transistors, which have a TO-1 metal case, are wired directly into the board, leaving a lead length of about 1 inch. These should be covered with sleeving to minimise the risk of short circuits. The transistors are fitted with flag heatsinks, part No. 56200, which are normally supplied with each complementary pair. These metal flags are then mounted in close contact with the chassis by means of tin screws and nuts. The flags should be secured individually to the bare chassis to ensure the best heat transfer—not two flags secured with one screw.

Polarised 2-pin sockets are used for the loudspeaker output terminations. These simplify speaker phasing and minimise the risk of shorting the output circuit. The earth return for the loudspeaker should be isolated from the chassis (apart from the earth connection on the board) and should not be connected to the earth return for the loudspeaker in the other channel.

Two 3-pin DIN sockets are provided

for the inputs and these are connected to the selector switch via dual shielded cable. The shield for each channel input is connected to the centre pin (pin 2) of the DIN socket, but no connection is made to the outer shield of the DIN socket.

The third pole of the selector switch was used for shield terminations. Readers who may wish to use this pole for any kind of switching function will have to mount a two-terminal miniature tagstrip on the switch to take these shield connections. The input wiring shield must not be connected to the chassis at any point apart from the connection made via the printed board. If this and other details regarding wiring layout are not noted and duplicated, instability or, at the very least, additional harmonic distortion, may result.

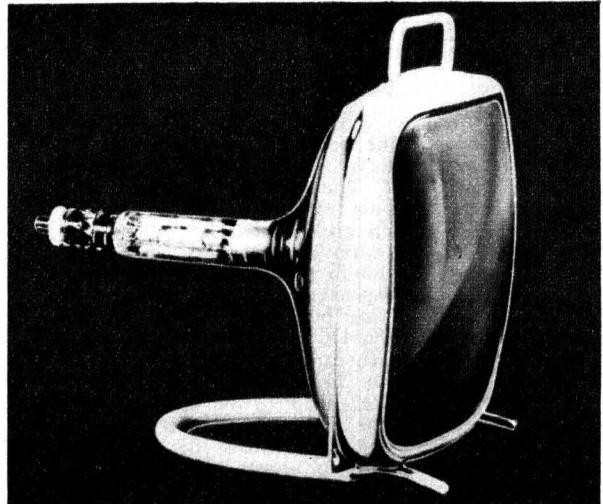
As the circuit and wiring diagram indicate, only one of the two shields of the dual input cables and the signal cable to the volume control are terminated at the input switch, to decrease the possibility of earth loops. The only connection to chassis from each amplifier channel is from the board to a 3-terminal tagstrip which also terminates the output from the bridge rectifier and which will accommodate a bleeder resistor if necessary. Other details concerning the layout can perhaps best be determined from the wiring diagram.

The power transformer used in the prototype was made by A&R, type 2155. The voltage from the 12.6 volt tapping at no load was 13.3 volts, which gives a margin for mains supply variations. Readers who want the maximum power available for 16-ohm loudspeakers may use the 15-volt winding but only with due attention to the DC output. If the DC supply voltage exceeds the required values of 19 or 21 volts (dependent on loudspeaker load to be used) a bleeder resistor of suitable power rating must be connected across the output of the rectifier to reduce the voltage to the stated value under quiescent conditions.

The bridge rectifier we used was a selenium type, Westinghouse LT91, which sells at a very economical price. As an alternative, an encapsulated silicon bridge rectifier, type MB1, is marketed by STC; it is more compact than the LT91, but there is a price difference of almost one dollar. The LT91 is mounted on the chassis, underneath the volume control/power switch, by means of two tin Whitworth screws and nuts. The MB1 bridge may be mounted similarly by means of one screw.

Readers may have reservations about using a silicon bridge rectifier with such a large order of capacitance (4000uF). However, each silicon diode in the bridge rectifier assembly is

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rated for a maximum surge current of 50 amps for one half-cycle at 50Hz and the small transformer used will saturate long before these current levels are reached.

A 6.3 volt pilot lamp is used, running at reduced voltage to extend its life and to lessen the possibility of hum being induced into the control wiring. It is connected between the 12.6 and 9.5 volt taps on the transformer via a pair of twisted wires.

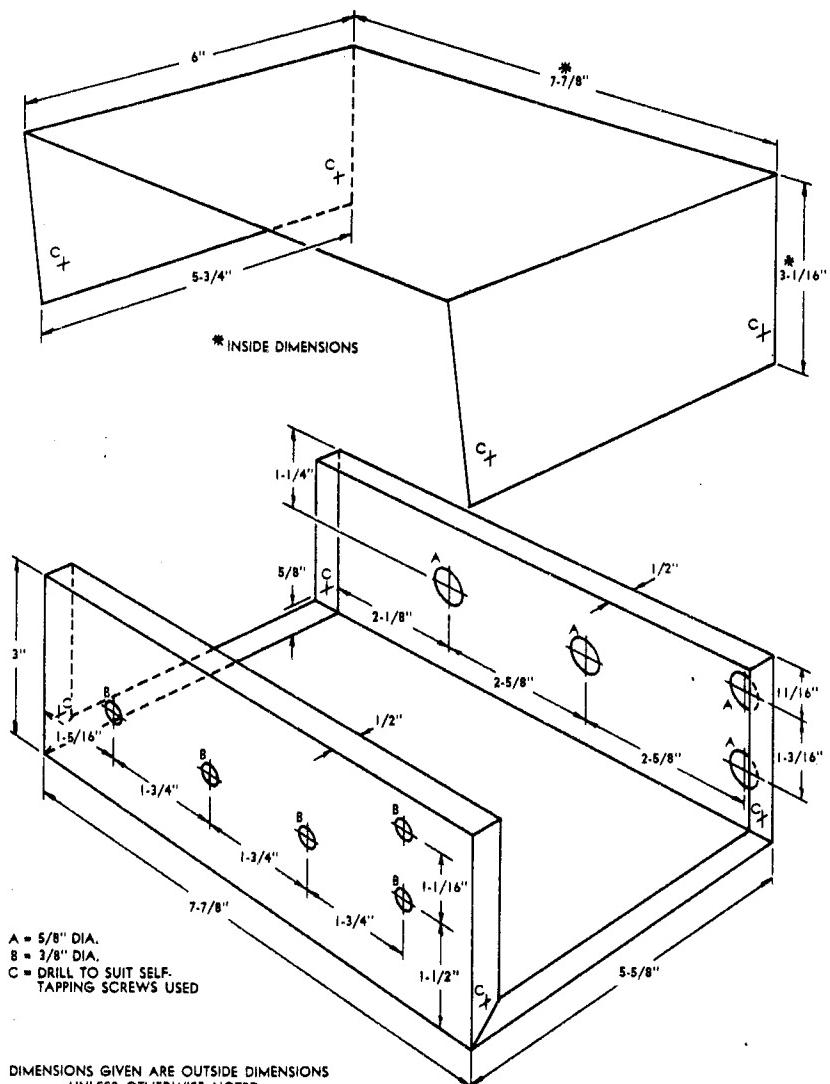
A suitable order of assembly would be as follows:

First, wire all the components and connecting wires into the board. Leave sufficient length on the connecting wires so that they can be trimmed to length later. Do not bend the pigtails too close to the component body or bend them too sharply. Solder quickly and cleanly and avoid overheating the components.

Incidentally, although the prototype has $\frac{1}{4}$ -watt resistors throughout, $\frac{1}{2}$ -watt resistors may be used, but should be high quality carbon film types. The four 1-ohm output transistor emitter resistors and the two 47-ohm bias resistors should be of half-watt rating.

Having wired the board, attention can be turned to the chassis. The rubber feet are retained with a screw and nut, the nut being held in the foot itself. The potentiometer and selector switch shafts should be cut to suit the knobs. Having installed the controls and input sockets, transformer and rectifier, etc., the appropriate wiring can be installed. The mains cord should be passed through a grommeted hole in the rear of the chassis, then between the chassis side flange and the transformer stack and finally terminated at the switch/pot. It is anchored by a clamp which is held by the same screw which retains one of the transformer lugs and the tagstrip for the rectifier and earth terminations.

Next, the printed wiring board can be installed. It is mounted on four half-inch spacers. The flag heatsinks should be secured firmly to the chassis as detailed earlier. The transistors and heatsinks may be given a very light smear of silicone grease to improve the heat transfer. Connections between



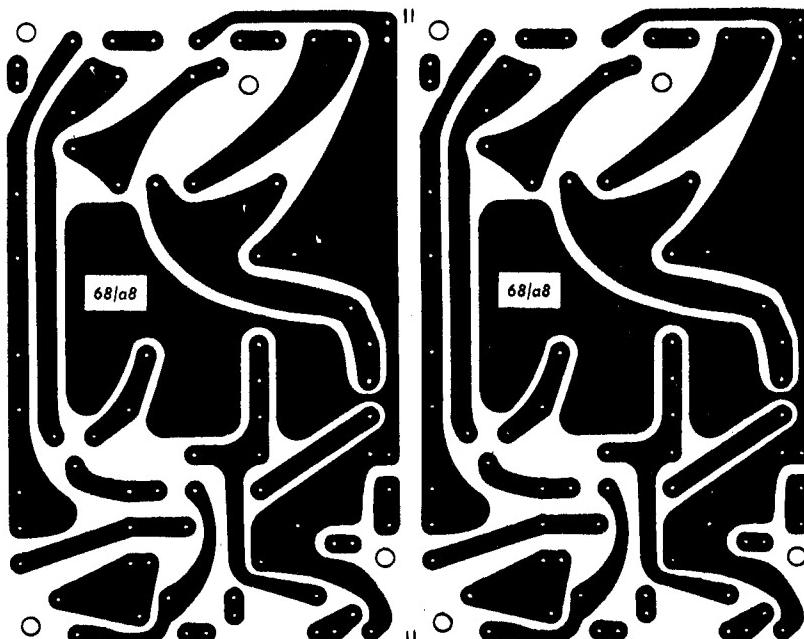
Here are details of the chassis and printed board for those who may prefer to tackle their own. Actual size of the board is 5½ x 4½ inches.

the board and the other components can then be made.

Finally, a front panel and knobs can be fitted. The prototype had a panel with a glossy black background and white lettering which contrasts with the turned aluminium knobs. In due course, kit suppliers will probably have available suitable panels. Those readers who find the selector switch difficult to operate with the small diameter knob may improve the "action" by lessening the spring tension on the ball-bearing in the "clicker" plate. This is easily done with a screwdriver.

The amplifier may be installed in a cabinet or used in a free-standing situation, in which case a cover is required. This was also made from 18-gauge aluminium, suitably bent and with a slight overhang at front and rear. The aluminium was covered with a plastic contact adhesive material, with a teak grain pattern. To ensure that the material adheres firmly, the surface of the metal should be roughened slightly with steel wool or a wire brush. The cover is attached by means of four $\frac{1}{4}$ inch diameter self-tapping round-head screws and flat washers. Care should be taken not to over-tighten the screws, otherwise the material may stretch.

So there it is; a compact amplifier which should give years of pleasure. We hope you like it. ■





Forum

Industry has wary eye on radioactivity

The dangers of exposure to excessive radioactivity have slipped out of the headlines for the time being but the matter has not been forgotten. Observations and articles in the technical press indicate that it is receiving attention from within the electronics industry in both Britain and the United States. Due note should be taken in this country particularly in respect to colour television receiver prototypes currently under development.

Conducted by the Editor

In "Electronics Weekly" for May 1, 1968 an article by K. W. Flitcroft takes up the theme "Keeping a personal eye on the hazards of radioactivity." The author sets out the background to the subject in such terms that one can do no better than quote his opening paragraphs:

"Radioactivity is a natural property possessed in varying degrees by many materials so that there has always been a low level of radiation to keep a Geiger counter ticking.

"This background count varies with locality and is normally in the order of a few milli-roentgens per day. There are some rocks containing minerals with a higher level than average to give a sudden burst of activity to a counter, but not until recent years has it been considered necessary to guard against the danger of injury.

"Since the employment of radioactive materials for various purposes began some sixty years ago, the number of uses has greatly increased and is still rapidly increasing. It is now essential to take adequate steps to prevent injury through overexposure.

"The cells of the body are constantly dying and being steadily replaced. This is a natural process but emissions from radioactivity kill the

cells whether healthy or not. When the rate of breakdown is too fast for the body to cope, the individual becomes sick.

"Whether anyone really knows for certain the long range effect of exposure to any particular level of radiation, is a source of controversy. Regulations generally prevalent in the world are based on levels at which there is no detectable injury.

"Around 1930 the U.S.A. formulated some laws regarding the use of radioactive materials and Britain had some early influence in the matter. Now the regulations in the form of maxima and guides are laid down by the International Commission for Radiological Protection. From these the relevant laws in individual nations are formulated.

"The permissible maximum of radiation incurred by an individual is given in regard to exposure from both external radiation and internal radiation, a distinction being made between the two.

"The first is concerned with emissions received from some external source while the second with radiation through material ingested, whether through breathing or eating. The latter is the more dangerous as the radio-

active material is thus closer to the internal organs.

"Radioactive isotopes are now no longer used only in scientific experiments, atomic centres, hospitals or dental surgeries; they are employed widely in industry as well. There are hundreds of applications such as for X-raying of castings and thickness of density gauges. Automation depends greatly on their services."

The author goes on to mention the mounting problem of radioactive waste materials, and suggests that high-power high-frequency RF energy and ultraviolet radiation cannot be lightly dismissed. To quote again:

"Civil defence authorities have ruled a dose of 25 Roentgens over a short period, as permissible for those engaged in rescue following nuclear attack. They state that after an exposure of 110 Roentgens one begins to feel really sick. At about 500 Roentgens the chances of recovery are 50 per cent while at 800 definitely nil."

"The individual, however, employed in research or industry receives nothing like the intensity permitted in the case of civil defence personnel during an emergency. Any such employee might expect to receive at the end of a whole year much nearer to 5 Roentgens."

From this point onwards Flitcroft's article goes on to discuss dosimeters of the type which various instrumentalities may require their staff to "wear" while they are in work areas where radioactivity may be a hazard. Such dosimeters may typically look like—and be worn like—a fountain pen, being colour-coded to distinguish the range of dosage which they are intended to record.

However, the very fact that such equipment and such requirements exist indicates an awareness of the problem and a willingness to cope with it, wherever it is recognised as such. The unease is not so much about situations where radioactivity is expected but those where it is not expected.

In saying this, it is necessary to rule out a couple of areas which received a thorough going-over in these columns a few months ago — monochrome television receivers and thermionic tubes which contain deliberate quantities of radioactive material. Little could be found to support a contention that these presented any kind of a public hazard.

However, in the United States, there is still a good deal of apprehension about colour television receivers, particularly those which were manufactured before many recognised the possibility of harmful rays being emitted from the EHT circuitry. The General Electric Company woke up the whole situation a year or more ago, when they recalled a line of

colour receivers for inspection and adjustment. Some of the receivers had been found to emit what was considered to be a potentially dangerous level of radiation.

"Electronics" for April 15, 1968 refers to a survey conducted by The National Centre for Radiological Health, in the Washington area. The magazine reports.

"The survey showed that 6 per cent of the sets produced excessive radiation.

"The test revealed some extremely high radiation leakage. Of the 66 sets leaking radiation above the accepted safe level of 0.5 milli-roentgens per hour (mR/H), 38 sets registered above 1.0 mR/hr, and three others actually hit 12.5 mR/hr — the maximum reading on the test instrument. Centre engineers believe the actual readings on these sets were much higher.

"Twenty-three sets gave readings of between 1.0 and 2.0, five between 2.0 and 3.75, ten between 3.75 and 12.5, and three over 12.5.

"The survey said the probable primary sources of X-radiation emissions were the high-voltage shunt regulator tube, the high-voltage rectifier tube, and the picture tube. However, in two sets, no specific source could be identified.

"James G. Terrill, the director of the centre, said the Washington survey included too few sets to yield an accurate nationwide estimate. He estimated, however, that 700,000 to 1.4-million colour TV sets in the U.S. leak excessive radiation.

"But instead of starting a nationwide campaign to halt the leakage, the centre is working with manufacturers to make certain that all new sets are tested before leaving the factory. Because of the shortage of trained technicians who are properly equipped with devices to detect and measure radiation, the centre is only recommending that owners take their sets to a repair shop to make sure the high voltage is set at the proper level. This usually reduces the radiation.

"At the same time, the centre was sponsoring a conference in Washington on detecting and measuring radiation from colour TV receivers. Up to now, there have been no uniform methods of detecting or measuring it. Although there are no definite plans yet, the centre and the Electronic Industries Association will probably organise a committee to work out recommendations."

AIR CONTROLLERS: Another group in the United States which has become somewhat apprehensive about X-ray radiation is the air controllers who, of course, have their counterparts in many nations. Whereas colour television viewers relax for a few hours during the week across the room from a TV set, air traffic controllers spend their working week at a console with one or two radar scopes pointing right at them, and with possibly other displays in immediately adjacent consoles.

(My editorial in the May issue referring to a "long line of orange-coloured radar displays" was in fact written after a couple of hours in just such an environment at the Manchester international airport.)

What the air traffic controllers are concerned about is whether proper safe-

guards are being taken to ensure that radar display equipment does not produce the same kind of stray radiation that has been detected in some colour TV receivers.

According to "Electronics," the matter is being investigated on behalf of air traffic controllers by the National Association of Government employees. To quote:

"Alan J. Whitney, executive vice president of the union, in testimony before Congressional committees, has implied that the Federal Aviation Administration's radiation safeguards are inadequate. The F.A.A.'s maximum exposure to ionising radiation is 100 milli-roentgens a week. Based on a 40-hour week, this equals 2.5 mR/hr. The generally accepted safe level is 0.5 mR/hr."

LASER HAZARDS: Yet another area which is receiving attention is that to do with laser development and application. "Electronics" has this to say:

"A survey made by the Public Health Service's National Center for Urban and Industrial Health in Cincinnati disclosed that 60 per cent of laser workers in the scientific instrument industry faced potential risk of eye damage or serious burns. The figure was based on a study on the use of 267 lasers in 43 plants in Massachusetts. The survey is now being extended to New Jersey and later will move to California.

The survey called laser safety requirements surprisingly lax. For example, only about 45 per cent of the firms required eye shielding in laser areas, and about 25 per cent of the goggles provided are inadequate. Only a few plants had laser warning signals or signs. At the same time that this report was released, the newly formed laser subdivision of the E.I.A. voiced approval of the radiation control bill passed by the House, which covers lasers, and organised a committee to work on laser safety studies and promotion."

Reading this, I recall a visit to an establishment in the U.S.A. where a lot of work was in progress on — and with — a variety of lasers. If there were warning notices, I didn't see them. If precautions were being enforced, they were not evident and they were not enforced on me, as a visitor.

Perhaps they were not needed — but this is what the discussion is all about!

RF FIELDS: Finally, there is the question of possible exposure to direct radio frequency fields of more than usual intensity. An article which I extracted from "Electronics Weekly" some 12 months ago (Aug. 23, 1967) draws special attention to this.

The author, D. Stoddart of Aveley Electric, emphasises that microwave equipment is assuming an increasing variety of roles in everyday existence. There are microwave ovens for heating foodstuffs, welding operations in the plastics industry, drying and bonding in the timber industry and still other applications in printing and graphics. While it can reasonably be assumed that the fields involved are either sufficiently weak, sufficiently dispersed or sufficiently isolated to prevent no hazard, there remains the question of the situations which could arise if the equipment is operated in an unwise or improper manner.

He suggests that the hazard is not

confined to microwaves but can extend to the more familiar UHF region and can be encountered in such everyday tasks as when an idle antenna is being overhauled in the immediate vicinity of other fully active systems. He observes:

"There are recommendations laid down by various international bodies and perhaps we must be thankful that they all seem to agree on the same maximum safe level of 10mW/cm².

"In the U.K., the General Post Office, in collaboration with the Government organisations and the Medical Research Council, published a booklet entitled "Safety precautions relating to intense radio frequency radiation" (HMSO Code No. 43-182).

"There are certain conditions which determine the level of 10mW/cm², the most basic being that this level is the average and not the peak power. Medically this is because the normal blood circulation of the body is sufficient to disperse any local sudden rise in temperature. Skin condition would appear to have little effect on the amount of damage inflicted."

While it is reassuring to be able to quote agreed limits for permissible radiation, Stoddart professes to be anything but happy about the instrumentation which is commonly made available to personnel to measure the field in which they may be required to work.

It is clearly futile for an instrument to pronounce an area "safe" if, in so doing, it ignores or responds poorly to a significant part of the frequency spectrum. This is also a problem if examination of the whole spectrum involves the physical changing of antennas on the instrument. Then there is the matter of polarisation which can lead to quite erroneous results unless the instrument is manipulated to check for all possibilities. The nature of the emission may also be significant in terms of the final reading.

But even apart from the capacity of portable instruments to cope with the basic measurement, there is the problem that such instruments have to be operated in the field which they have to measure. The engineer or rigger has to enter the questionable zone in order to find out that he shouldn't be there!

Stoddart expresses puzzlement about the attitude of engineers. He says:

"With correction charts quite accurate readings are feasible, which open the way to applying the monitor to aerial gain and some polar diagram checks."

"It is difficult at times to understand the psychology behind the action of some engineers when they are confronted with the problem of radiation.

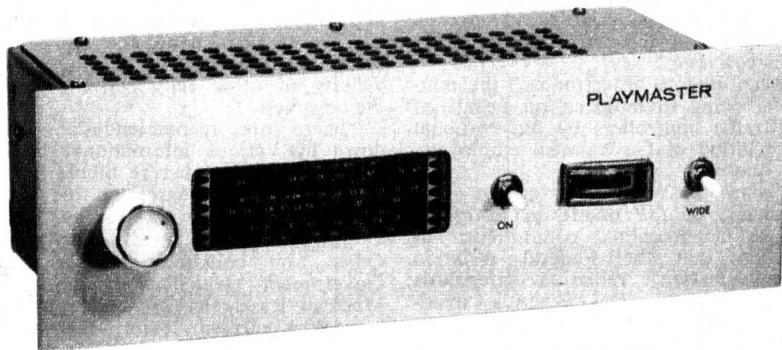
"Often there has been the case where qualified engineers have an almost trepid fear of the radiation levels existing around their own work bench, yet when actual measurements are taken the level hardly exceeds the 1mW/cm² mark.

"On the other hand, engineers working every day on high-power transmitters take the occasional "warming up around the dish" for granted. The general impression one receives from within the industry is that electromagnetic radiation is something we have come to live with."

PLAYMASTER

122

PROGRAM SOURCE



As a follow-up of our discussion last month, on the problems relating to the design and development of a transistor broadcast wide band tuner, we now present a practical unit. Built mainly on a printed board, it is easy to make and align.

By Ian Pogson

Although we have presented a number of quality tuners in the past, and which have done quite a good job, recently there has been a quickening of requests for a solid state high grade tuner. As we pointed out last month, meeting this demand presents considerable problems. The electrical point of view has already been discussed and we can now take a closer look at some of the other aspects, such as physical problems, availability of components, and the actual presentation.

We elected to build this version of the tuner into the same standard cabinet as was used for the original Program Source described in November, 1959. This cabinet may be mounted on a panel which is common to the rest of the equipment or built as a separate unit. In any case, its dimensions match those of most of the control units we have described. Some alterations were necessary to the metalwork to accommodate the new design, and drawings will be made available to the various chassis manufacturers. Ready-made metalwork should be available, but copies of the drawings will be available through our Information Service if required.

We must hasten to acknowledge that this cabinet style may not suit all tastes and needs. With this in mind, we are planning to present the same unit in a free-standing metal box, such as was used for the Playmaster III Program Source.

Although it has not progressed beyond the thinking stage, we also have it in mind to integrate this new Playmaster 122 Program Source with a solid state stereo amplifier, in the one case. We hope to say more about that in the foreseeable future.

From a mechanical point of view, we set ourselves a challenging task to fit the new board and other accessories into the relatively small case. However, it has been done and, apart from the need to follow a systematic method of assembly, no difficulty will be had in construction.

Access to the underside is unob-

structed and the top is reasonably clear for all practical purposes. The whistle filter and the mains transformer do cover some of the components but, if access should be necessary, it is an easy matter to move the filter or transformer out of the way. The whistle filter and mains transformer are located at opposite ends of the case, to avoid any possibility of hum trouble. With the top and bottom covers in position all controls, including pre-set potentiometers, are readily accessible.

Dials are always a problem these days but we managed to solve this one by using a scale which is readily available from RCS Radio, along with the other items of hardware which are available separately. On the other hand, RCS Radio have undertaken to supply a complete kit of parts for the dial drive assembly.

At this point, let us look at the circuit diagram. It contains quite a number of interesting features and we will explain the various functions and make other comments as may be necessary.

Between the aerial terminal and the base of the RF amplifier transistor (TR1), is an attenuator; a 1K pre-set potentiometer. This is to provide control over very strong signals, such as from nearby transmitters. Otherwise, cross modulation could be a problem.

Between the RF amplifier and the self-oscillating mixer (TR3) is a band-pass pair of RF coils. These coils have been made available by Aegis Pty. Ltd. As explained last month, a bandwidth of 20KHz is required and this is obtained by over coupling the pair of coils. Top and bottom coupling is used so that the band-width is maintained right across the broadcast band. The tuning gang is of the paddleless type, made by Roblan. The RF sections have a capacitance of 200pF each, and the oscillator section 90 pF. The gang which we used has trimmers built into it.

Following the mixer are two LC filter circuits centred on 455KHz. One filter is conventional and has the normal sharp characteristic. The other

consists of two parallel resonant circuits which are overcoupled, to give a band-width of 20KHz. These filters are made up of standard transistor IF transformers made by Aegis and physically match the RF and oscillator coils. Note that, in the overcoupled pair, the secondary of the first transformer is not used.

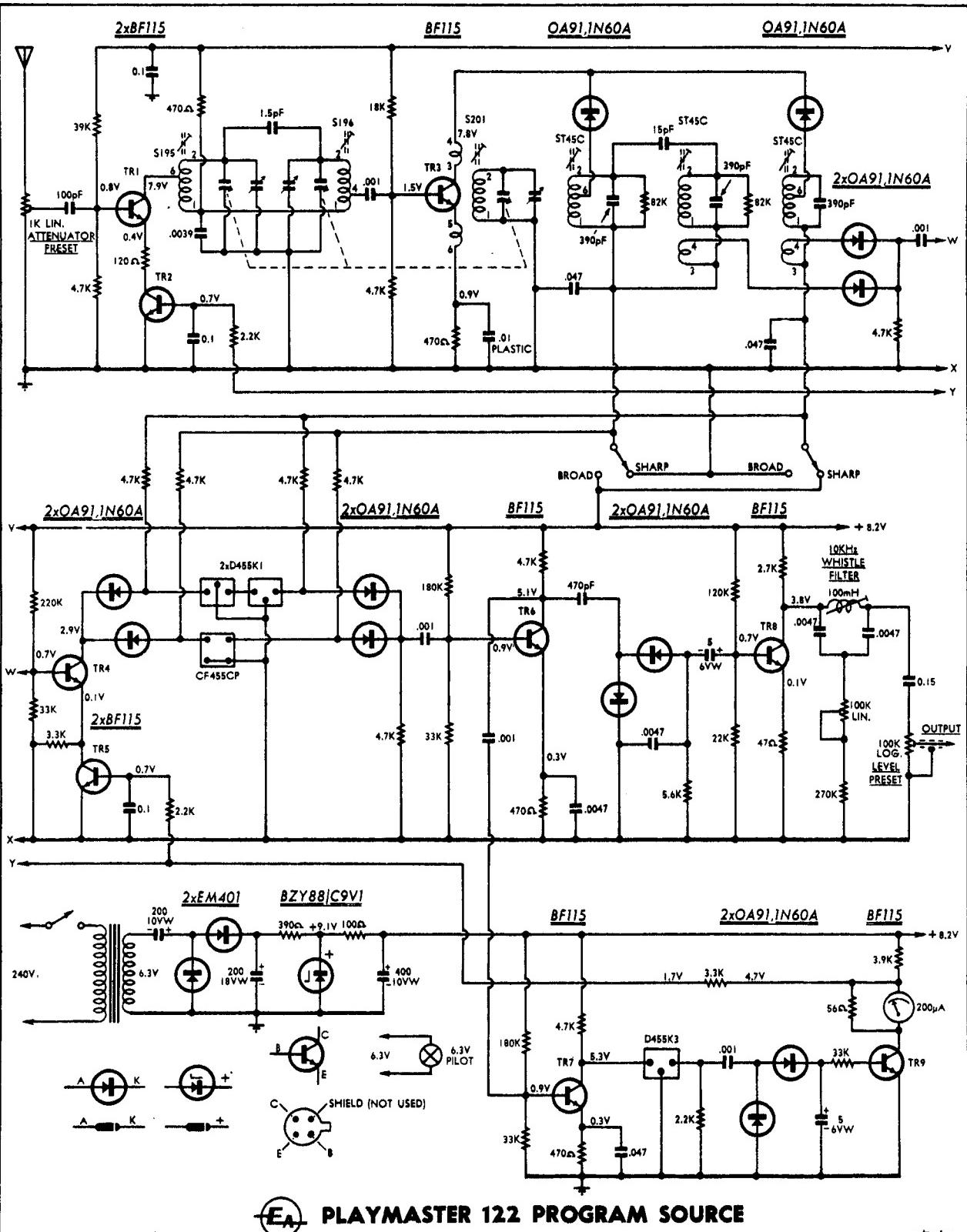
Either filter may be selected to give the required pass-band. Selection is achieved by forward biasing the collector circuit diode of the filter required. The diode of the unwanted filter is automatically reverse biased. The filter output is selected in a similar manner and fed to the base of the first IF amplifier (TR4). The potential which biases the respective diodes is applied via a simple miniature double pole double throw toggle switch.

Instead of the LC filters as used in the first stage we have used ceramic filters in the second stage. For the sharp position, two relatively simple filters (DK455K1) are connected back-to-back. These, together with the signal tuned circuits and the first IF filter, provide the overall maximum selectivity of the system. For the wide position, a much more elaborate ceramic filter unit is used. This has 20KHz band-width. In a similar manner to the previous stage, the appropriate filter is selected by biasing germanium diodes in the input and output circuits.

The two back-to-back ceramic filters each have a band-width of 5KHz at the 3dB points. A similar single unit is used in the AGC amplifier circuits and has a band-width of 8KHz at the 3dB points. In common with most components, these are manufactured only within certain tolerances. In this particular application, it is necessary to state, when ordering, that these three units be a matched set to a tolerance of plus or minus 1KHz.

The wide-band ceramic filter which we have specified, type No. OF455CP, has a nominal band-width of 18KHz. However, in practice they are somewhat wider than this and are adequate for the job. A response curve we took of our filter is shown, and tells the story very clearly.

The second IF amplifier (TR6) is capacitively coupled to a voltage doubler diode detector. Output from the detector is fed into the base of an audio amplifier (TR8). This amplifier has sufficient negative current feedback in the emitter circuit to avoid overloading. The audio output from this



PLAYMASTER 122 PROGRAM SOURCE

2/TU/27

stage is of the order of one volt RMS. for 100 per cent modulation.

A whistle filter follows, tuned to 10KHz. The circuit is a bridged-T and the 100mH coil is wound on a Mullard type FX2240 pot core. RCS Radio are making these filters as a complete assembly on a small printed board. The board contains the coil, two capacitors, and a 100K potentiometer, pre-set very close to frequency.

A 270K resistor, connected in series with the 100K potentiometer, is connected between the filter and the main board.

As the level of audio from the whistle filter is more than necessary for most amplifiers, a 100K pre-set potentiometer is also provided. This can be adjusted to suit the amplifier sensitivity.

For AGC purposes, some of the sig-

nal is picked off the collector of the second IF amplifier (TR6). This signal is fed via a .001μF capacitor to a buffer-amplifier stage (TR7). Following this amplifier is the 8KHz ceramic filter already mentioned. The function of this filter is to retain a peaked response in the AGC system, even when the tuner is switched to the broad position. This is necessary in order that the tuning meter will pro-

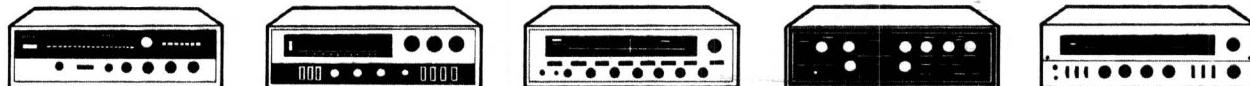
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vide an unambiguous indication of correct tuning. The filter is deliberately selected to be as broad as possible, consistent with a distinctive peak, in order to minimise overload (and possible distortion) which may be evident at the "edges" of the pass band as the set is tuned across a station, while in the broad position. (See last month's article.)

The signal for AGC is detected in a voltage-doubler diode arrangement and the recovered DC is used to drive the base of the AGC amplifier (TR9). Under no-signal conditions this amplifier has no forward bias applied, the collector current is very small, and the tuning meter shows practically no reading. When a signal is received, the voltage applied to the base is in proportion to the strength of the signal. The transistor conducts accordingly and the collector current is shown on the tuning meter.

As the maximum current through the meter can be in excess of the rating of the movement, the coil is shunted to give a full scale reading on very strong signals. The meter is type No. EW5 or V303, with a 200μA movement.

Above the tuning meter is the 3.9K AGC amplifier load resistor. From this point, the AGC is fed to the base of each of the two control transistors (TR2, TR5), one each in the emitter of the RF amplifier and the first IF amplifier. This line provides a forward bias for the base of each control transistor so that, under no-signal conditions, it is fully conducting. The voltage across these transistors and, therefore, the resistance in the emitter of the respective amplifier, is quite low. Under these conditions, there is very little negative feedback.

When a signal is received and the voltage at the collector of the AGC amplifier falls, the forward bias on the control transistors is reduced. The collector-emitter resistance increases, giving rise to a certain amount of negative feedback. This reduces the gain of the controlled amplifiers.

The power supply is built into the unit and any small transformer delivering 6.3 volts at 300 milliamps or so, will do the job. The transformer in the photographs is type PF1728. It has two 6.3 volt windings, each rated at one amp. In this particular case, we used one winding for the dial lamp and the other for the power supply. However, there is no reason why only one winding should not be used for both functions.

There are a number of other transformers with a 6.3 volt secondary and which are somewhat smaller than the PF1728. There is also at least one small unit which has a nominal 6.3 volt secondary winding, with a number of taps to accommodate different current drain requirements. It is possible that some of these transformers may be suitable, but we have observed a voltage regulation problem which may overload the second filter electrolytic.

In cases where a dial lamp is not needed, then it may be possible to use a very small transformer. We are investigating these alternatives and more will be said in a later article.

Assuming 6.3 volts AC from the transformer, the voltage doubler provides a DC voltage in excess of that required. The 390 ohm resistor and the zener diode reduces this voltage

and pegs it at a nominal 9.1 volts. A further stage of filtering is provided by the 100 ohm resistor and 400μF capacitor. Should it be desired to operate the tuner from a 9V battery this could be connected at the "9.1V" point in the circuit, discarding the zener diode and all components ahead of it.

Provision is made on the printed wiring board for variations in the power

up. By adjustment of the attenuator, signals up to one volt or so can be handled.

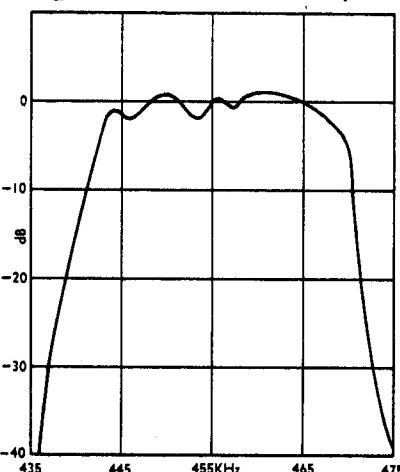
Although the unit may appear complex, construction is simple and straightforward. There is quite a lot to be done but provided it is done systematically and in more or less the right order, a few hours' work will see the job through.

Perhaps the best place to start, is the complete assembly of the printed wiring board. All the components are identified on the coded photograph and it is only necessary to follow this closely.

The six coils may be mounted first and soldered into place. When soldering the coil contacts, make sure that the assembly is properly seated on the board. The filters are next, with the same precaution needed. There are five links to be fitted to the board. Four of them may be tinned copper wire and the one nearest the oscillator coil should be insulated hookup wire.

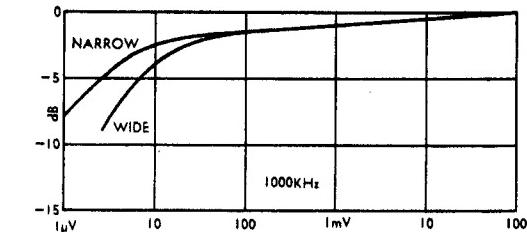
Resistors and capacitors may be fitted next, making sure that the electrolytics are fitted with correct polarity. When fitting the diodes—there are 15 in all—take care not to overheat them with the soldering iron. Again, correct polarity is important. Reversed polarity may lead to damage in some instances or, at best, failure of the circuit to function correctly.

Fit the gang lugs through the holes provided and take care that the as-

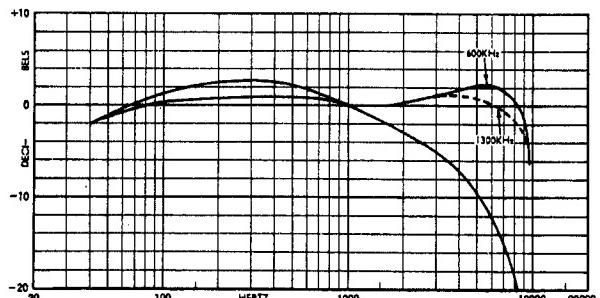


A response curve, taken in our laboratory, of the CF455CP ceramic filter used in our prototype tuner. It easily satisfies the 20KHz bandwidth requirement.

The AGC characteristic of the tuner for both wide and narrow positions. A pre-set aerial attenuator extends the signal range in high signal level areas.



Response curves showing performance in the narrow position, and in the wide position at both ends of the band. The rapid roll-off around 9KHz is due to the whistle filter.



supply details. Provision is also made for the wide band ceramic IF filter to be replaced with two back-to-back IF transformers, similar to the arrangement in the previous stage. Details are beyond the scope of the present article but we propose to deal with these alternatives in a later issue.

The transistors used in the prototype are all type BF115. At the time of writing, we are investigating alternative transistors. So far we have found sufficient variations in circuit requirements, when using some other types, to call for further investigation.

The audio frequency response for the two selectivity positions can be seen from the curves. The AGC characteristics for both narrow and wide positions is also shown. It can be seen from the latter that the sensitivity is useful for signals with a level of only a few microvolts. This is with the aerial input attenuator turned fully

assembled and seated properly on the board. There are seven points which have to be soldered. As they are all rather heavy connections, a hot soldering iron, applied for sufficient time, is needed, to make a good joint. Avoid overheating, as this can be detrimental to the board and adjacent components. Now solder the 1.5pF top-coupling capacitor, across the end lugs on the top of the gang.

The only components left are the transistors. Once again take care to solder without overheating. It is also vital to be quite sure that the right connections are made. In the case of the BF115, there are four leads, one a shield and normally connected to earth. In this application shielding is not required, and we simply bent this lead upwards and left it at that. The mixer-oscillator transistor, close to the gang, should be so bent that the rotors of the oscillator section of the gang

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will clear it by an eighth of an inch or so.

Nine leads of hookup wire have to be soldered to the board, the lengths depending on their ultimate destination. The leads are: one each for the aerial input and audio output, one for the whistle filter, a pair for the tuning meter, and the remaining four for the selectivity switch.

This completes the board proper. The whistle filter may now be mounted at the top right corner, near the audio output. The filter assembly, on its own printed board, is stood off the main board with two one inch spacers, threaded at each end. This allows ample clearance underneath.

Having mounted the filter, connect the lead from the main board to the lug at the outside edge of the filter board. Fit the 0.15uF capacitor from the other lug on the filter board to the hole in the main board which is just behind the output potentiometer. The 270K resistor is connected between a hole in the main board (directly beneath the outside edge of the filter) and the rotor of the filter potentiometer.

Connect the four leads to the selectivity switch, according to the diagram. Connect the other two leads to the meter, with due regard to polarity. It is also necessary to connect a shunt resistor directly across the meter terminals. The value which we found to give full scale reflection on very strong signals, was 56 ohms.

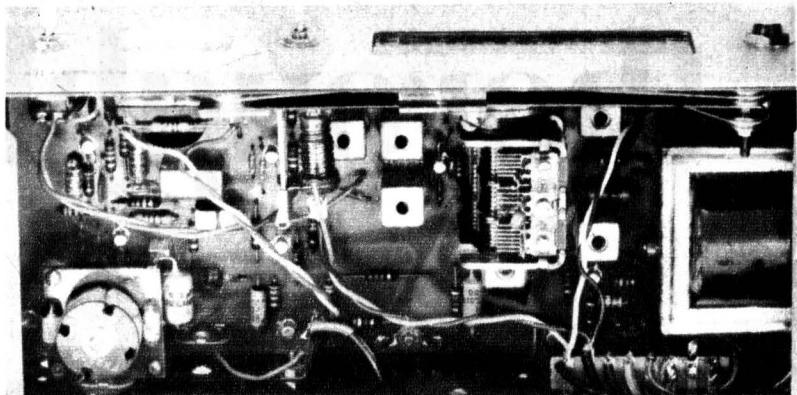
This brings the assembly to the point where it is possible to test and align it if you wish. Before doing so, however, make a thorough check to be sure that there are no errors or omissions. Having satisfied yourself of this, it only remains to feed 6.3 volts AC into the appropriate points on the board. A preliminary alignment can be undertaken at this stage, with the limitation that the dial calibrations are not yet available. Alignment details are given later in the article.

Assuming that all is well so far, the board can be mounted in the case. The board is held at five places, using $\frac{1}{8}$ in countersunk screws and $\frac{1}{8}$ in spacers. The countersunk screws are needed to retain a flat surface where the bottom of the case is to mount, and the spacers to provide clearance between the bottom and the printed board. Under the nut of the screw at centre back, place a double ended solder lug or two single lugs.

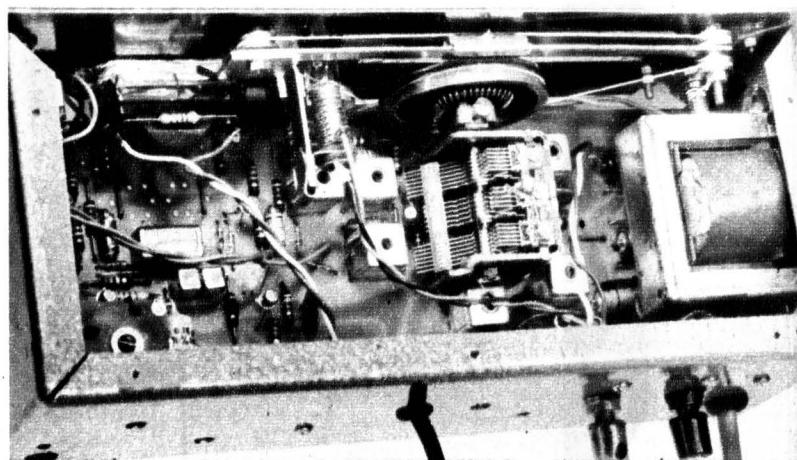
Fit the aerial and earth terminals to the back of the case and solder the aerial lead from the board to the terminal lug. From the earth terminal lug, run a wire to the lug under the centre screw of the printed board. Fit a 3-tag strip on the back of the case and to the left of the output potentiometer. Terminate the audio output lead at one of the insulated lugs on the tag strip. Run a wire from the other insulated lug, to the earth lug on the printed board.

From this tag strip, fit a short length of microphone or other low capacitance coaxial cable and run it through a grommet in the adjacent hole. This is the audio lead to the amplifier and the length should be limited to less than two feet if at all possible. Excessive length may result in loss of high audio frequencies, which we have gone to much trouble to preserve.

Next, consider the front panel assembly. Before the dial scale is mounted,



A top view of the complete tuner. The whistle filter is in the bottom left hand corner, the power transformer at the right hand end of the board, and the eight terminal tag strip just below it.



Another top view, from a slightly different angle, showing details of the dial assembly, meter mounting, and terminals on the rear panel.

PARTS LIST

1 Set of metalwork	1 3-tag strip
1 Printed board, No. 68/8t	1 8-tag strip with two mounting feet.
1 Dial Kit	
1 Knob	
1 Miniature toggle switch, SPST	RESISTORS ($\frac{1}{2}W$ 5pc)
1 Miniature toggle switch, DPDT	1 47 ohms 1 5.6K
1 Meter 200uA, type V303 or EWS (scale unimportant)	1 56 ohms 1 18K
1 Mains transformer 6.3V 1A (See text)	1 100 ohms 1 22K
1 Whistle filter assembly, No. 129	1 120 ohms 4 33K
1 Roblan paddleless gang, with trimmers	1 390 ohms 1 39K
1 Coil (Band-pass pair) S195	4 470 ohms 2 82K
1 Coil (band-pass pair) S196	3 2.2K 1 120K
1 Oscillator coil S201	1 2.7K 2 180K
3 IF transformers ST45C	2 3.3K 1 220K
1 Murata ceramic filter CF-455CP	1 3.9K 1 270K
2 STC ceramic filters EFC- D455K1)	10 4.7K
1 STC ceramic filter EFC- D455K3) (matched set)	
1 1K linear pre-set tab potentiometer	CAPACITORS
1 100K linear pre-set tab potentiometer	1 1.5pF NPO ceramic
9 BF115 transistors	1 15pF NPO ceramic
12 OA91, IN60A diodes	1 100pF plastic or ceramic
2 EM401 diodes	1 470pF plastic
1 BZY88/C9V1 zener diode	5 .001uF low voltage plastic
2 Stand-off pillars, 1in long, threaded each end	1 .0039uF low voltage plastic
3 Spacers, $\frac{1}{8}$ in long, 1/8in clearance	2 .0047uF low voltage ceramic
1 Dial lamp socket	1 .01uF low voltage plastic
1 Dial lamp, 6V	3 .047uF low voltage ceramic
2 Terminals, 1 red, 1 black	3 .01uF low voltage ceramic
	1 0.15uF low voltage plastic
	2 5uF 6VW electrolytics
	1 200uF 10VW electrolytic
	1 200uF 18VW electrolytic
	1 400uF 10VW electrolytic
	SUNDRIES
	Hookup wire, solder lugs, solder, microphone cable, 3-core power flex, 3-pin plug, screws, nuts, etc.

a piece must be cut from each end, to reduce the overall length to 4-5/8in. This can be done by scribing lines on the perspex then breaking it by resting it on a firm straight edge. Mount the dial scale with countersunk screws. Immediately behind the scale and spaced by the thickness of a nut, is the black dial backing plate. At the end of the scale nearest the tuning meter is fixed the jockey aligning pulley, spaced off with another nut. Fix the slider bar, with the pointer, lamp bracket and three pulleys as shown in the photograph. Finally, the tuning meter is screwed in place, making sure not to exert too much pressure on the lugs.

A small "L" shaped bracket, 5/8in x 5/16in x 1/8in wide, is made from a piece of brass or tin plate of about 22 gauge. This is used to stabilise the front edge of the printed board, by fixing it to the front panel in front of the gang. Screw the bracket, by its long side, to the underside of the board. Place the dial drum over the gang spindle but do not tighten the grub screw.

Now screw the panel, as it is assembled so far, to the main case with four countersunk head screws. A fifth screw is used to hold the panel to the bracket just described. The panel face is held in place by the two toggle switches and the dial drive spindle.

Perhaps the worst job in the whole construction, is the awkward task of stringing the dial drive. This is not peculiar to this tuner; rather is it an unfortunate fact of life with such devices. Patience is the ingredient which will win with this little job.

Slip the cord through the two holes in the pointer slide and then over the pulleys, one at each end of the slider bar. One end of the cord then passes over the aligning jockey pulley, before entering the slot in the drum. The other end of the cord is passed three times around the drive spindle, over the pulley above, once around the drum and through its slot. The ends of the cord are tied one to each end of the spring which stretches around the drum boss. The cord tension must be adjusted against the spring such that a smooth drive action is obtained.

Immediately above the aerial and earth terminals, is space for an 8-tag strip, with two mounting feet. This strip may be used to terminate leads for the power supply or as we will see later, can perform a variety of functions to suit individual needs. In the prototype, we used this strip to terminate the mains input and the "On-Off" switch on the front panel. In addition, we terminated the two 6.3 volt windings, with one side of one winding connected to an earthed mounting lug. A pair of leads is taken from one winding to the input of the power supply. Either from the same winding, or the other one, another pair is run to the dial lamp socket.

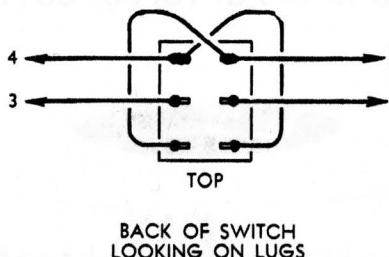
If you use this tag strip to terminate a mains cord, it is important that the cord be clamped near the grommet hole in the back of the case. At this point, construction is complete and we can get on with the job of testing, alignment and setting up.

If you have not already made a preliminary check and test as mentioned earlier, then a check should be made before power is applied. Assuming that all is well, connect the audio lead to amplifier, turn both the audio output

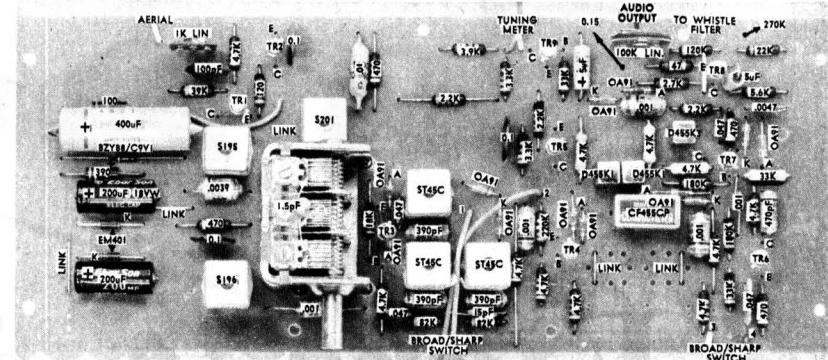
and aerial potentiometers full up and search for signals. Depending on your location, either a short piece of wire, or something larger may be required for an aerial.

For the alignment process, no equipment except an aligning tool is really needed. The first thing to be done is to lock the dial and gang together correctly, so that the "law" of the one coincides with that of the other. In the absence of a pointer set line on the dial scale—a serious omission—we had to determine, on a trial and error basis, where this should be. Close the gang fully, slide the pointer to the right, and set it 3/32in to the left of the vertical line representing the end of the scale.

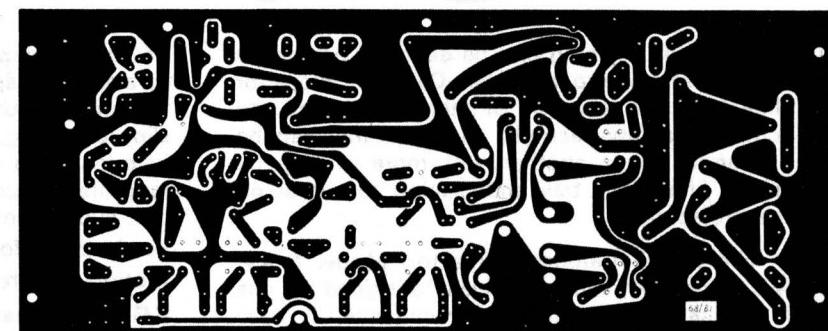
Set the selectivity switch to the narrow position. Tune in a strong station and if the tuning meter indicates more than about three-quarters of full scale, turn down the aerial attenuator until this meter reading is obtained. Adjust the single IF transformer for a peak



A wiring diagram for the selectivity switch. The lead numbers refer to similar numbers shown on the coded photograph.



A coded photograph showing the layout of the completed board before assembly into the case. Use of this in conjunction with the printed wiring board should make wiring a simple job.



A reduced reproduction of the printed wiring board. As shown it is transposed left to right with respect to the photograph above. In other words, if the board in the photograph is transposed end for end, the pattern will be as shown above.

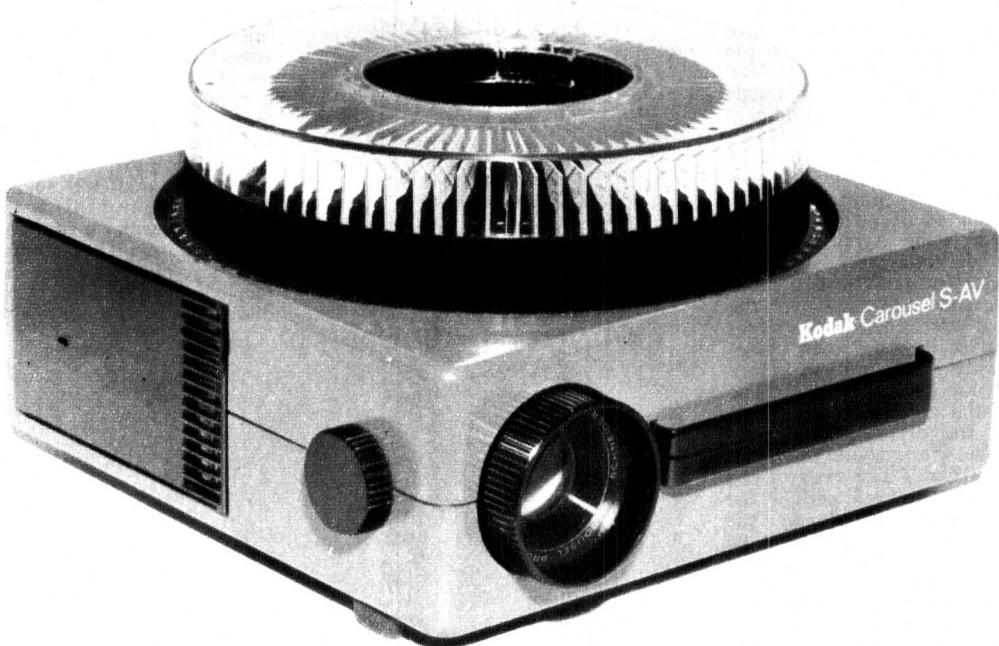
on the tuning meter. Re-tune the dial for a maximum peak on the meter and check the IF transformer again. It may be necessary to do this a number of times, to ensure that the IF transformer is in the optimum position for the three ceramic filters.

Tune a station at about 600KHz and one which is positively identified. Adjust the slug in the oscillator coil until this station tunes on the dial at the correct position. Now tune a station at about 1300KHz. The trimmer on the oscillator (centre section) of the gang is adjusted until the station tunes to the correct dial setting. Return to the other station and adjust the slug if necessary, to correct for any change. This process must be continued until the stations remain at their correct positions.

Now tune across the dial and check that all stations fall into their correct scale positions. In our case, the result was not as good as we would have liked, and we had to accept some compromise in the final adjustment. This error is probably the end result of several minor errors, involving the law of the dial scale, the law of the gang, and the absence of a "set pointer" mark on the dial scale. The compromise involved altering the oscillator coil slug on 2FC, which is on 610KHz, so that it tuned to about 620KHz. Most of the stations then coincided very closely with the dial scale calibrations.

Now we have to align the RF bandpass filter and we suggest that you make the adjustments at the same positions on the dial as previously. As the circuits are overcoupled, special measures must be taken to ensure correct alignment. The technique is to damp one of the coils with a 10K 1/2W

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80 bubble-chamber events
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resistor, with leads as short as possible, and then adjust the other coil.

Tune to the station at about 600KHz and adjust the slug in the undamped coil, for a peak on the tuning meter. Now tune to the station towards the other end and adjust the same coil by the trimmer on the relevant section of the gang. Repeat this process as before, until you are satisfied that both ends are correct. Remove the damping resistor and solder it across the coil which has been adjusted and proceed as before. Remove the damping resistor and the job is done. The alternative is to use a sweep generator and CRO, but this is not necessary.

The remaining section to be adjusted, is the pair of back-to-back IF transformers. As these are overcoupled, the same technique is used as before. Tune a station accurately on the meter and with the switch in the NARROW position. DO NOT TOUCH THE DIAL TUNING. Set the switch to the broad position and adjust the undamped coil for maximum peak. Change the damping resistor to the other coil and proceed as before. Remove the damping resistor.

And that is all there is to it!

Apart from alignment, a number of other adjustments have to be made for optimum performance. The audio output potentiometer may have to be turned back to avoid overloading the input of the amplifier or control unit. This setting can soon be found.

The amount of aerial and the setting of the aerial attenuator will be dictated by the location. If there are no strong signals, then several feet of aerial will be needed with the attenuator turned right up. At the other extreme, if you are close to one or more stations, just a few feet of aerial will suffice and the attenuator may have to be turned well back. The criterion of attenuator adjustment is that it must be set so that cross modulation from a strong signal on other stations is not a problem. It may be necessary to arrive at a compromise with this setting and it can only be determined by experiment and experience.

This leaves only one more adjustment to be made: the whistle filter. If you use an RCS filter it should be adjusted fairly close to frequency. Set the 100K potentiometer on the filter to about mid position. If you are lucky, you may not have to make any further adjustment. If the 10KHz whistle is still audible, adjust the screw in the centre of the pot core, slowly and carefully, for maximum attenuation. Then the 100K potentiometer is adjusted for further attenuation. This process should be repeated for best results.

As with all radio tuners, it is very important that it be tuned correctly to the wanted station. Proper use of the tuning meter will ensure that this is done. Tuning is a little more definite when the switch is set to the narrow position. Most users prefer to switch to narrow, tune, then switch to broad.

Sometimes readers have trouble in locating one or more components for our projects. Normally, your local supplier should be able to get everything for you. However, it does not always work out that way and we suggest that you contact the agent or distributor in the capital of your State, as the next logical step. If this fails, we suggest that you contact the head



A READER BUILT IT!

Circuits and devices which we have not actually tested in our laboratory but published for the general interest of beginners and experimenters.

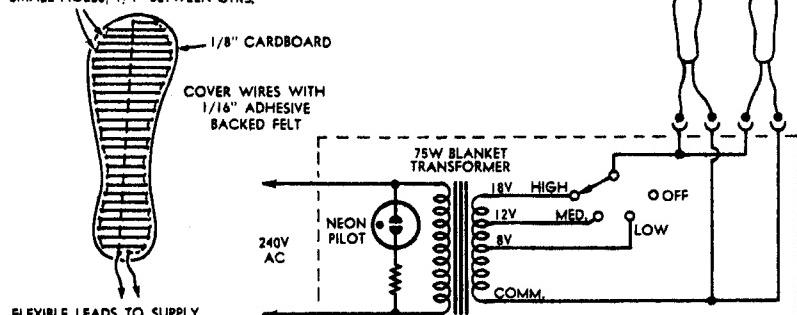
ELECTRICALLY HEATED SHOES

Mr C. S. Fisher, 18 Langdale Avenue, Revesby, N.S.W. 2212, sends this description of a pair of electrically heated innersoles. They are intended to provide foot comfort for persons standing or sitting for long periods in one place.

Readers may be interested in making a pair of "electric footwarmers" suitable for use on cold nights whilst in the workshop, hamshack, watching television, etc. They consist of thick cardboard innersoles fitted with heating elements of resistance wire, and they fit into the user's shoes or slippers. The innersoles plug into a low voltage power supply fitted with a four position control switch.

As illustrated in the diagram, the resistance wire is stretched in parallel rows across the top of the cardboard, being looped underneath through small holes spaced about $\frac{1}{4}$ in apart along each side. The wires are taped in position and covered with a thin overlay of adhesive-backed felt or similar material.

SMALL HOLES, $\frac{1}{4}$ " BETWEEN CTRS.



The resistance wire size depends on the power supply available. My unit uses a 75W electric blanket control unit having output voltages of 18, 12, and 8 volts. Excellent results were obtained with approximately 15 ohms resistance in each innersole, producing a warming power for each foot of 21, 9.5 and 4.3 watts for the "high," "medium," and "low" positions respectively.

I used three yards of wire in each innersole, the wire being 24B&S Nichrome wire with a resistance of 5 ohms per yard. Various types of resistance wire are available under such trade names Eureka, Nichrome, Advance, Bright Ray, Constantan, etc., and which do not necessarily have the same gauge/resistance characteristics.

Possible alternative power supplies are transformers for model train controllers, battery chargers, etc. (Editorial Note: In the interest of safety, only such transformers as are designed and approved for use in applications where the user is likely to come in contact with the secondary, should be used. Filament and similar type transformers may not have adequate insulation between primary and secondary for such an application. It would also seem to be desirable to earth one side of the secondary.)

Once having decided on the output voltage available, a few "ohm's law" calculations will determine the resistance required in each element. Aim for about 15 to 20 watts maximum per foot, bearing in mind that this maximum power will only be required for a short time, even on the coldest nights.

office direct. To assist readers here is a list of the head offices of the major components distributors.

Murata ceramic filter type CF-455CP and the toggle switches: IRH Components Pty. Ltd., The Crescent, Kingsgrove, N.S.W. 2208.

Ceramic filter types EFC-D455K1 and EFC-D455K3 (matched set); Standard Telephones and Cables Pty. Ltd., Moorebank Avenue, Liverpool, N.S.W. 2170.

Coils: Aegis Pty. Ltd., 347 Darebin Road, Thornbury, Vic. 3071.

Wiring board, whistle filter, and

dial kit: R.C.S. Radio Pty. Ltd., 651 Forest Road, Bexley, N.S.W. 2207.

Tuning meter, type V303 or EW5: Radio Despatch Service, 869 George St., Sydney, N.S.W., or Broadway Electronics, Cnr. Broadway and City Rd., Sydney, N.S.W.

Robian paddlesless gang, with trimmers: Watkin Wynne Pty. Ltd., 32 Falcon Street, Crow's Nest, N.S.W. 2065.

And there you have it. This is the first version of the wide band tuner you have been asking for, and we hope you like it.

When you need more than one microphone
you need a new modern designed . . .

SHURE

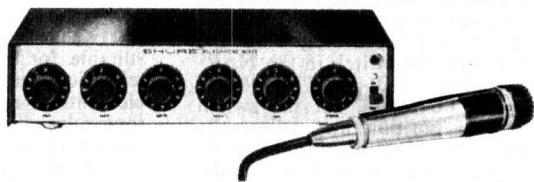
MICROPHONE MIXER

The practical, efficient and economical M68-2

This mixer is unique in that it satisfies the needs of most public-address systems and serious tape recording enthusiasts. Light enough to be portable, simple to operate and modest in cost, it strikes a happy medium between the expensive, heavy and complex permanent-installation type mixer and the extremely low-cost units of limited usefulness.

THE M68-2 FEATURES:

- Four microphone inputs with individual slide switches mounted on rear panel for selection of low impedance or high impedance.
- One high level auxiliary input suitable for tape, tuner and accessories.
- Individual volume control to balance each of the five inputs.
- A master volume control to simultaneously control level of all inputs.
- A high impedance auxiliary output.
- A DC power supply jack to supply 26 volts DC for use with accessories.
- A facility for connecting two or more mixers together to obtain additional microphone inputs.



SPECIFICATIONS:

Frequency Response: Flat plus/minus 2db from 30Hz to 20,000Hz (cps). Hum Noise: 70db below rated output. Equivalent Input Noise: 150 ohm.

For the Professional the M67 MICROPHONE MIXER

A compact, lightweight and economical microphone mixer/remote amplifier specifically designed for studio and remote broadcasting, recording and sound reinforcement.



THE M67 FEATURES:

- An illuminated VU Meter calibrated plus 4 and plus 10 dbm out.
- Extremely low noise and RF susceptibility.
- Wide, flat response.
- Two-level headphone monitor jack.
- AC or battery operation.
- Noiseless automatic switchover to battery if AC line fails.

SPECIFICATIONS:

Frequency Response: Plus 2db from 20 to 20,000Hz. Gain: 90 db max; 150 ohm microphone into 600 ohm line. Noise: 120db; Equivalent input broadband noise. Distortion: Under 1% from 20 to 20,000Hz at plus 10dbm out. Inputs: Four low-impedance microphone; one line, bridging or 600 ohms. Outputs and Levels: plus 18 dbm max; 600 ohm line; minus 44dbv max microphone. Size and Weight: 11 3/8" x 7 1/2" x 2 1/2"; 4lbs, 3oz.

For the Entertainer the PE7ORM-2 REVERB B/Mixer

This Shure Reverb/Mixer enables you to add reverberation, adjust the volume of each microphone or instrument for perfect balance, and feed this blended sound through a single amplifier or P.A. system. Adjustable reverberation simulates natural echoes of a large concert hall — gives your group the big sound.

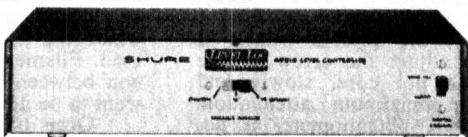


SPECIFICATIONS:

Gain: At 1,000Hz. 5.0 mv input produces outputs as follows:—
High v/mic. 6.7v Guitar amp. 22.5mv Power amp. aux. 85mv.
Frequency Response: plus minus 2db from 30Hz to 17,000Hz
Hum Noise: 60db below rated output. Input Impedance:
Inputs suitable for high impedance dynamic and ribbon microphones and electrified instruments. Net Weight: 3lbs. Dimensions:
11 1/2" x 3 1/4" x 2 1/2".

THE PE7ORM-2 FEATURES:

- Each channel is completely independent of the others.
- Up to 4 inputs per mixer.
- Standard connection to any amplifier.
- Built-in, Adjustable-Intensity reverberation.



SPECIFICATIONS:

Input Impedance: High, 100K ohms; low, 500 ohms.
Frequency Response: Flat 20 to 20KHz plus minus 2db.
Signal to Noise Ratio: With respect to 10 microbar input 60 db
Distortion: Any input distance selector position: 3% maximum.
Battery Life: 250 hours.
Compression Action: 40 db change in input gives approximately
6db change in output level.
Dimensions: 11 3/8" x 5 1/4" x 2 1/2".
Net Weight: 2.2lb.

Now . . . to improve audience Communications the M62 "Level-loc" audio level controller.

The "Level-loc" is a transistorised, variable input level controlling device especially designed to keep its electrical output constant although the input signal from the microphone may vary considerably.

THE AUDIO LEVEL CONTROLLER:

- Permits the speaker or entertainer to use the microphone at varying distances and positions without a change in output volume — eliminates blasting and fadeouts.
- Upgrades tape-recording systems by controlling the volume being fed to the recorder. This prevents distortion and overloading of the tape recorder which is caused by excess volume from the microphone.
- Permits more than one paging system operator to use the public address system without a change in output volume of that system.
- Prevents feedback from becoming "ear-splitting" and excessively loud.

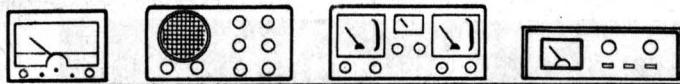
SPECIFICATIONS:

Input Impedance: High, 100K ohms; low, 500 ohms.
Frequency Response: Flat 20 to 20KHz plus minus 2db.
Signal to Noise Ratio: With respect to 10 microbar input 60 db
Distortion: Any input distance selector position: 3% maximum.
Battery Life: 250 hours.
Compression Action: 40 db change in input gives approximately
6db change in output level.
Dimensions: 11 3/8" x 5 1/4" x 2 1/2".
Net Weight: 2.2lb.

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The Serviceman



ATTITUDE TO SOLID STATE DEVICES

Major problem facing all servicemen is the increasing use of solid state devices in domestic electronic appliances, and the need to face up to the challenge they represent. With the exception of TV sets, most locally produced appliances have already switched to solid state design, and TV sets are only a matter of time. What is your attitude to this situation?

Most servicemen make no secret of how they feel about solid state appliances, which impels me to pose the question; why do we seemingly have such a violent dislike for transistorised equipment in general — and portable radios, in particular?

I first became aware of this opposition a long time ago; long before I had seen inside one of the devices myself. It was when they were first dribbling into the country — mostly as presents brought in by travellers returning from overseas — and a colleague had been unfortunate enough to be stuck with one of them.

When I asked him how he had fared, his reply was unprintable. As far as he was concerned, these devices were the product of some unholy alliance which, if it had been solemnised at all, must have been by some form of blood pact.

This reaction came as a shock. Thus far I had considered only the advantages of the new techniques; the efficiency of solid state devices, the undoubtedly economics and reliability of printed wiring, and so on. To hear one of my own kind condemn these things in such violent terms seemed nothing short of sacrilege. I felt sure it was nothing more than a case of a conservative mind condemning something new — simply because it was new.

This idea seemed to be confirmed when I tried to find out just what it was my friend didn't like about the devices, only to draw a complete blank. When it came to the point he just couldn't nominate the reasons. As he expressed it; "I just can't get used to the idea. Maybe they are a major step forward for the design engineers, but they're real cows of things to service."

And that was that!

Naturally, it wasn't long before I found myself faced with one of these mighty monsters — and learned how wrong I had been in judging my colleague. By the time I had finished tracking down a relatively simple fault I was quite prepared to agree with him; they were "real cows" to service. And, as time went on, I heard the

same story more and more frequently. Some fellows wouldn't have anything to do with them at any price; some accepted them to keep faith with customers, but farmed them out to one or other of the "specialists," who had arisen to meet the demand; some simply struggled through as best they could, writing off the extra time needed to "experience."

But nobody liked them. Everybody agreed on that. Nor has time changed the situation. Much has been said and much has been written about this attitude, but, as yet, no one seems to have answered the question I asked my colleague all those years ago; WHY don't we like them? WHY are they hard to service? And since nobody else seems inclined to, I am going to try to provide some of the answers myself. Most of these are the results of observations and notes I have made while working at the bench. Some have come from colleagues after I have started the ball rolling with my own thoughts.

First, there is the elementary difference between transistors and valves. At a servicing level this probably is not very serious. Most of us have made the mental transition from plate, grid and cathode to collector, base, and emitter; from high impedance to low impedance; and, where necessary, from positive supply rails to negative. With a little experience typical voltages are remembered, just as they were with mains-operated valve sets.

If this was the only problem, I imagine most fellows would have taken it in their stride. Unfortunately, use of transistors almost automatically implies several other characteristics — in particular, a fair degree of miniaturisation and the use of printed wiring boards. In many cases it also implies a foreign make and, for this reason, a possible lack of service or other data.

Even more serious is the lack of replacement parts. Even assuming that one successfully tracks down the fault, there is little future in the exercise if the culprit turns out to be one of the transformers, audio or IF, a transistor with a type number no one has ever heard of, or, in fact, almost

anything other than resistors and capacitors. Most important, who pays for the time in a case like this? The customer is disinclined to, because he is getting nothing tangible for it. On the other hand, the serviceman can hardly be expected to give away several hours of free time on every such occasion.

Miniaturisation is, at the very least, a nuisance. To those of us who cut our teeth on a 9 x 15 chassis, with components sized proportionally, the pocket transistor set takes a deal of getting used to. It also reveals any deficiencies in one's eyesight, possibly forcing a decision to have one's glasses changed, or have them prescribed, as appropriate.

The worst aspect of miniaturisation is that many components are so closely packed together that it is impossible to read their values or, in some cases, even be sure whether they are a resistor, capacitor, or something else. Particularly where no circuit diagram is available, positive identification of components and determination of their values is an essential first step to servicing.

Then there is the printed wiring board. The main problem here is the simple fact that the wiring is on one side and the components on the other. It seems a natural enough arrangement until you try tracing the circuit. In the conventional chassis, with all the components on one side, it was simple enough to start at some easily recognised part of the circuit, trace a lead to the next component, identify it, proceed to the next component, and so on. In addition, the mere presence of valve sockets, with their readily recognised connections, provided ready-made reference points to help one on the way.

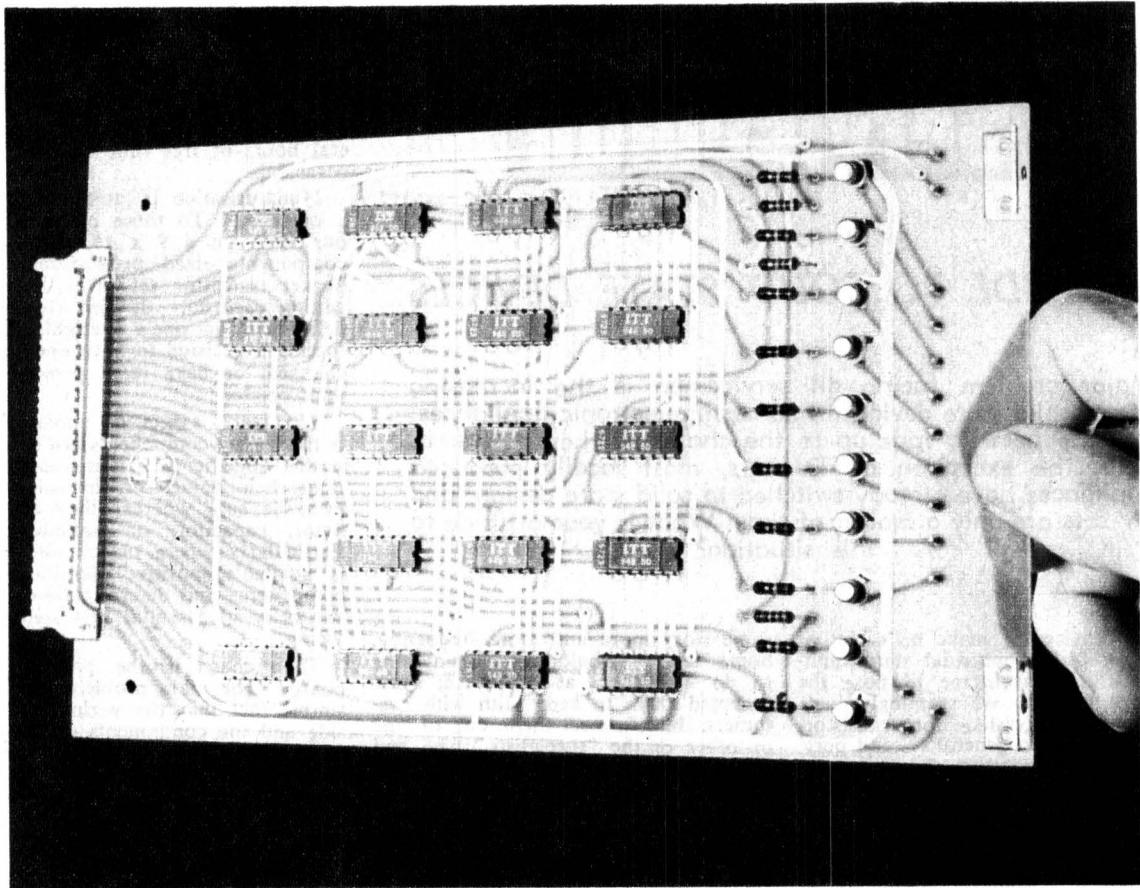
Not so with a printed board. Regardless of which side of the board one starts on, it is not long before the board has to be turned over and the trail picked up on the other side. And it is often very difficult to be sure that a given point on one side is positively identified on the opposite side. To make matters worse, transistors not only have no sockets, but are frequently mounted hard down on the board, where it is impossible to even see the leads, let alone identify them.

A further hazard is the flimsy nature of the external leads running from the board to the speaker, battery, and various external terminals. As the board is turned back and forth in an effort to trace the circuit, there is a very real danger of breaking these. While not a tragedy, it has a high nuisance value.

And I once had the temerity to ask why my colleague didn't like them!

Why are they made like this and what can be done about it?

There seems little doubt that they are made like this simply because this is the most economical way. From the manufacturer's point of view, the printed wiring board was a major production breakthrough. It did away with expensive hand wiring, eliminated mistakes, made possible automatic soldering and, in fact, reduced wiring to nothing more than another component. It so changed the economics of set production that there is little doubt that we would not even have our miniature portables but for its development.



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Nor is it any exaggeration to suggest that the manufacturer of at least the very tiny devices has not given overmuch thought to the problems of service, for the simple reason that he does not envisage overmuch service being done on them. In fact, it appears that the situation in this country is a highly artificial one, whereby various taxes, duties and loadings result in the market price being much higher than in the country of origin, or even other countries to which they are exported.

As an example, the Editor recalls that, during his recent overseas tour, he saw any number of 6-transistor pocket radios for sale in the U.S. for the ridiculous price of \$US3.95. And these were imported. At that price, who would want to repair them? Or could afford to repair them? I don't know what American service charges are like, but there are not many Australian servicemen who will knock on your door for much less than that figure. On the basis of normal time and component costs, the owner may well finish up with a bill for an amount which would have bought him a couple of new sets.

What can be done about it? Frankly, I'm not completely sure. My main purpose in writing what I have has simply been to set down the various aspects of the problem. And, on the basis that recognising a problem, or the nature of it, is half way to solving it, I hope that it may have been of at least limited benefit.

In any case, one thing is certain. Solid state techniques, printed wiring boards, and all that these imply are here to stay. While we may find some legitimate excuse in the case of miniature portables, and write them off as "not worth fixing," the same approach cannot be adopted for domestic radios, car radios, stereo systems, and TV sets.

These represent considerable capital outlay, and the owner is justified in expecting that they be serviced. Moreover, he is entitled to expect that this be done at a reasonable price. If a competent serviceman cannot do the job at a reasonable price, and stay in business, then it is time the manufacturers and servicemen got together and thrashed the problem out.

In this regard I understand that at least one local manufacturer is currently planning a TV set constructed on the modular principle — a plug-in module for each major section of the set. When a fault develops the serviceman identifies the section at fault, replaces it with a reconditioned module at a fixed charge, and returns the faulty module to the manufacturer who reconditions it for use in someone else's set.

This may well be the answer to many service problems, particularly with the added complexity of colour TV just over the horizon. But, in the meantime, there are going to be a lot of electronic appliances which will need to be serviced by the more conventional techniques. So we may as well learn to live with them.

Fortunately, not all solid state appliances are as difficult to service as the miniature portable radios. All locally manufactured devices, as well as the better known imported ones, have circuit diagrams and service data

available. The extent of such data varies but, in the best cases, it includes wiring board diagrams with components superimposed on them. Thus equipped, one is infinitely better off than when struggling with miniature portables of unknown origin.

These thoughts lead naturally into my main story for the month. One solid-state appliance which I am continually encountering is the portable tape recorder which, considering the popularity of these devices, is not surprising. More and more frequently, a successful service call to repair a TV set prompts the question, "Do you know anything about tape recorders?"

At first I was rather diffident about the idea, partly for reasons already stated and partly because, in truth, I didn't know much about tape recorders; at least not in the practical sense. While I had as good a theoretical knowledge of magnetic recording as most of my colleagues, I wondered whether this was good enough. While I could probably track down most faults, given time, I was a good deal less confident about doing it economically.

On the other hand, I sensed that servicing these devices might have its own particular advantages. They are the kind of device which, usually, is not needed urgently. Unlike the TV set, which "must" be fixed before the favourite evening program — I often wonder what tragic fate befalls those unfortunate customers whose "must" cannot be satisfied — a tape recorder is used much less regularly. It is quite common for the owner to say, "Well, take it and have a look at it. I'm not in a hurry for it, so leave it until it's convenient."

And a few jobs like that can turn a momentary slack period, which might otherwise be frittered away, into a profitable one.

So, after I had successfully tackled a few jobs as special favours for customers who were facing one kind of emergency or another, I decided that these devices were less frightening than they appeared superficially, and that I should be able to handle them within the normal servicing prices structure. The only proviso I made was that, initially, I would stick to those brands for which circuits and spare parts are readily available in this country.

Having made this decision, it seemed a good omen when the next machine to appear on the shop counter was of a brand with which I was already familiar. Most importantly, I had a circuit of it and I knew that the local agents carried good stocks of spare parts, readily available to servicemen.

I emphasise this latter point because some organisations carry replacement parts only for their own service departments, and are not in a position to supply the trade. Before tackling a piece of imported equipment, make quite sure that the local agent is in a position to supply spare parts.

The customer was one of my regulars. I was rather surprised to see him with the machine, because I was unaware that he owned one. As it turned out, he didn't — and that was the main part of the problem. He had borrowed it from a close friend, and was on the point of returning it

when he had the misfortune to drop it. It wasn't a big drop; the carrying strap had slipped off his shoulder as he turned to walk around the front of his car, the machine had hit the bumper bar, then the ground. The only superficial damage had been a minor scratch on the leather carrying case.

He had hastily opened the case, switched the machine on, and set it to the replay mode. He gave a sigh of relief when the tape replayed normally. Later, however, it occurred to him that he should check the record function. Even as he began setting up, he realised that the level meter was not functioning, while a further check indicated that the same meter, which also serves as a battery voltage indicator, was not functioning in this mode either. At this point, scared that he might do further damage if he persisted

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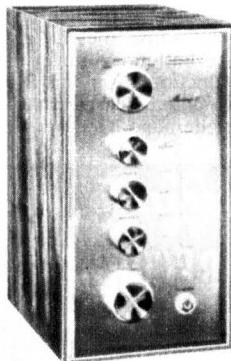
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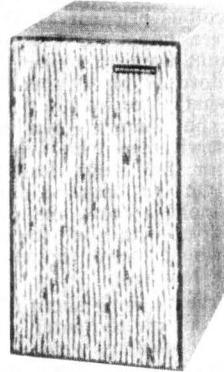
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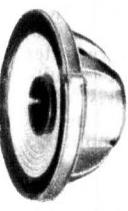
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8
inch



AXIETTE 8
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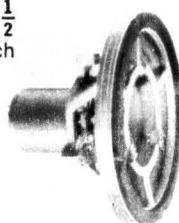
TWIN AXIETTE 8
 $8''$ —6 watt



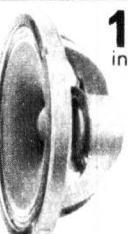
AXIOM 80
 $9\frac{1}{2}''$ —6 watt

AXIOM 10
 $10''$ —10 watt

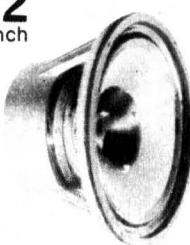
9 $\frac{1}{2}$
inch



10
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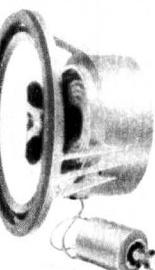
12
inch



AXIOM 201
 $12''$ —15 watt

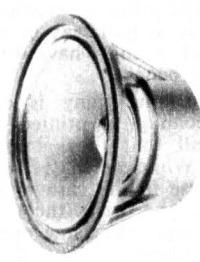
AXIOM 301
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with his tests, he sought my aid. Needless to say, he was very worried and embarrassed by the situation, and indicated that expense was no object provided I could restore the machine to full working order.

My first reaction was that it seemed unlikely that any electrical circuitry would have been disturbed by what was, after all, only a minor accident. It seemed far more likely that the meter had suffered mechanical damage and was jammed. I slipped the machine out of the case, held it with the meter at eye level, and gave it a quick twist. The needle moved up the scale and back again quite smoothly, with no sign of sticking, and continued to do so each time I tried it. So that disposed of that theory.

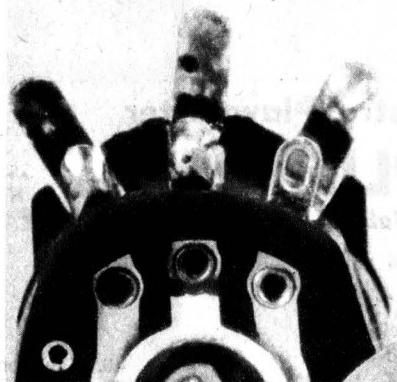
Nevertheless, I did not completely rule out a meter fault. It seemed to me that the needle was noticeably biased towards the zero end of the scale, though I had no way of knowing whether this was intentional or not. If it wasn't, and assuming that the movement in this simple meter followed standard practice, then it could be due to one of the hairsprings having come adrift. This would not only bias the needle in one direction, but also open the circuit to the meter coil.

In any case, whether it was the meter or the associated circuitry, the meter was the logical place to start. By removing the knobs and dress plate I was able to withdraw the meter on the end of a few inches of slack cable. Unfortunately, there were no terminals which would permit me to test the meter at this stage. I was able to remove the meter cover, held by two small screws, and examine the meter movement. As far as I could see there was nothing wrong, but I was unable to be sure of this. I decided to replace the cover and trace out the meter leads.

I took another look at the circuit. The meter was switched between each of its functions by means of a single pole two position switch, this latter being an auxiliary device on the back of one of the potentiometer controls.

There followed a certain amount of wire tracing around the control, made somewhat awkward by the compact nature of the assembly and the use of multi-wire cables between the controls and the printed wiring board. On the other hand the circuit was clearly laid out and the wires clearly colour coded, so it was only a matter of exercising a little patience. Finally, I slipped the control out of its mounting hole, and this made everything a good deal easier.

With the leads identified, I isolated the meter connections so that I could test the meter. A handy source of current for jobs like this is the ohmmeter section of the multimeter, making sure that one selects that range which uses the lowest voltage and involves the lower current. In this case the meter movement was listed on the circuit as having a sensitivity of 100uA — only 1/10 the current in the ohmmeter circuit — so I clipped an additional resistor on the end of one of the test prods to keep the current down to a reasonable level. Then I made a brief connection to the meter leads. The needle flicked up the



The switch portion of the switch pot, showing the centre lug broken just below the rivet.

scale without hesitation, and I knew that I had to look elsewhere for the trouble.

The next likely suspect was the switch itself. Admittedly, it seemed unlikely that the accident could cause damage to such a component, but I was beginning to wonder whether the bump had really contributed to the trouble, or whether the fault had simply decided to "happen" at or about the same time. I have known stranger coincidences.

My next test determined that the lead which supplied battery voltage for the battery monitoring function was, in fact, energised at the switch terminal. By unsoldering this lead from the switch contact and connecting it temporarily to the meter lead I was able to simulate the battery monitoring function and cause the meter to read. Similarly I was able to simulate the level indicating function again successfully. So that was it; the fault was in the switch.

The next question was, did the agents have a replacement? A phone call confirmed that they did, and that it was only a matter of arranging to pick it up. Since they were on the other side of the city, and the customer was anxious to get the machine back to his friend with the least possible delay, this presented a minor problem. Knowing that my customer travelled this way to work of a day, I rang him and suggested that the job could be finished a lot sooner if he was prepared to act as messenger boy. He was only too happy, and delivered the control to my shop first thing the following morning.

It was then a fairly routine job to replace it and put everything back together. There were no complications and I ultimately delivered the machine, in fully operational condition, to the very relieved customer. I was also able to give him a detailed account of the exact cause of the fault, for what this was worth, in relieving any "guilt complex" he may have suffered as a result of the unfortunate accident.

Once I had fitted and tested the replacement control, I couldn't resist the temptation to examine the old unit and determine exactly what had failed. The rear cover was riveted in place, so one of these had to be drilled out. Then I was able to swing the cover to one side and what I found is clearly shown in the accompanying photo-

graph. In simple terms, the centre contact had broken near the bottom of the securing rivet.

But why? Or when? And to what extent was it connected with the accident? I imagine that the accident was only indirectly responsible for the failure. It seems inconceivable that a relatively minor jolt could cause such a break unless the metal was already seriously weakened at this point. In fact, I am inclined to the theory that the metal was already broken, the lower portion being retained by the lower edge of the rivet. The jolt was simply sufficient to dislodge this rather tenuous hold. Close examination with a small magnifying glass convinced me that this was entirely possible.

As to why the lug broke in the first place I can only speculate. However, it is significant that the lug is required to bend at this point, the switch action being initiated by a vertical movement of the shaft. Even so, I suspect that there must have been a weakness in this part of the metal right from the start, since I doubt whether metal fatigue alone would cause such an effect, even in a normal lifetime and certainly not in a relatively new machine, such as this was.

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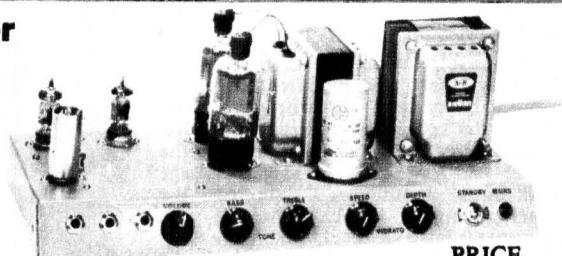
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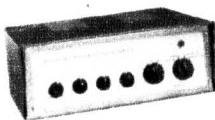
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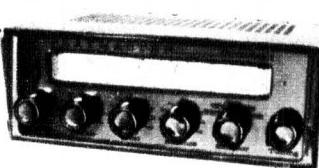
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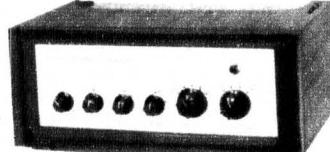
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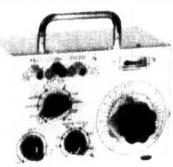


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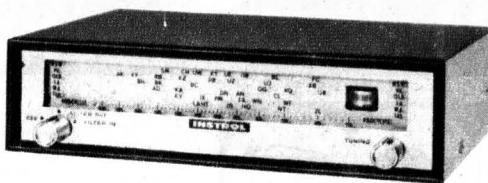
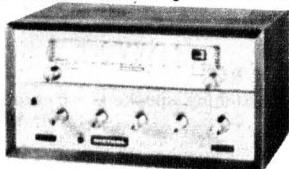
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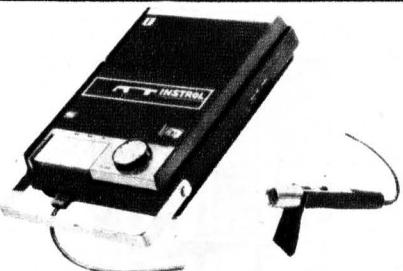
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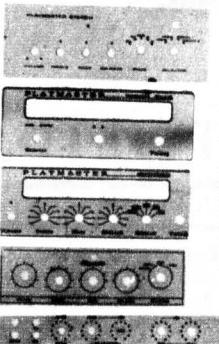
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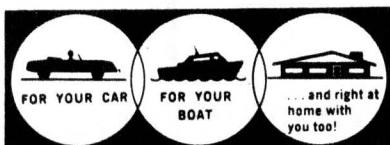
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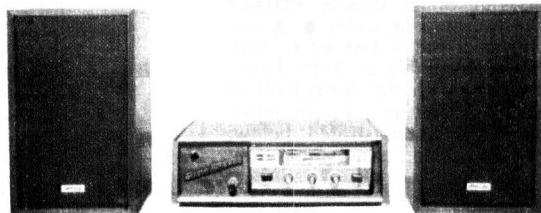
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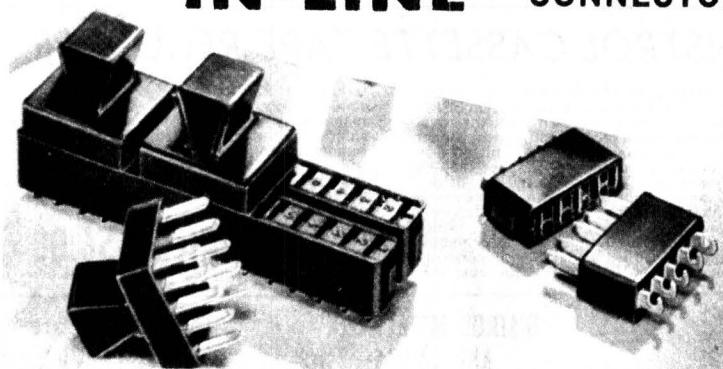
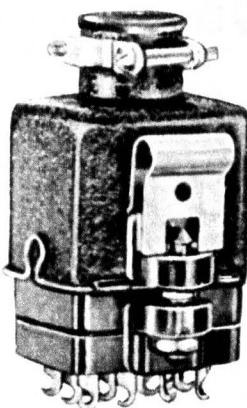
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DC-AC INVERTERS FOR FLUORESCENT LAMPS

This article describes two DC to AC inverters intended primarily to operate fluorescent lamps and using off-the-shelf transformers. The simpler unit will operate fluorescent tubes of up to 13W rating, while the larger unit can handle a nominal 20W load.

By Anthony Leo

Over the years, we have received many requests from hobbyists for an inverter design that would enable fluorescent lamps to be used in tents, caravans and boats, where the only supply available may be 12V— or even 6V— DC.

It is perhaps logical to ask why readers would want to go to so much trouble when ordinary incandescent lamps would be so easy to install.

In terms of light output efficiency, fluorescent lamps are normally credited with a distinct advantage over incandescent lamps of the same nominal wattage. Indeed, the advantage is considerable in domestic fittings of the 240V 40W variety, where manufacturers' literature suggests a ratio of about five times in favour of the fluorescent unit.

The advantage is likely to be much diminished for lower power fluorescent units compared with low voltage lamps of comparable wattage. Because of their shorter, stouter filaments and the higher operating temperatures which become possible, low voltage incandescent lamps achieve higher efficiency, while the efficiency of a battery-powered fluorescent system suffers from the losses inherent in any practical inverter. It would also appear that low-power fluorescent lamps are inherently less efficient than the higher power units.

Efficiency apart, however, a fluorescent tube has the very great advantage that its light is emitted from a large surface area, of moderate brightness. The more diffused light and the softer shadows make for a much more pleasant visual situation.

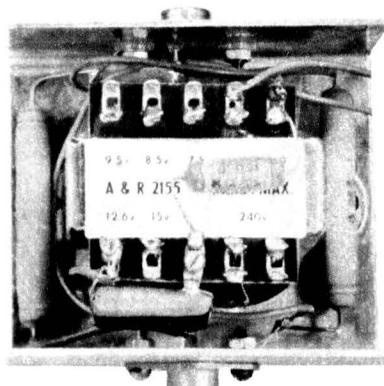
A few years ago, the idea of building a transistor inverter around a non-specialised off-the-shelf transformer would not have been entertained because of the acute danger of voltage spikes in the waveform punching through one or other of the transistor junctions. This danger still exists, but to a lesser extent because transistors can now be specified having much higher figures of breakdown voltage.

While the two specific designs which follow can be regarded as satisfactory in this respect, readers who may wish to experiment further along similar lines should proceed with caution. The voltages present in the primary circuit should be monitored during development with an oscilloscope having a fast rise time and calibrated accurately in terms of P-P deflection. Development should start out with heavy primary damping, which can subsequently be reduced as judged safe from the CRO pattern.

Initially, it was our idea to make only a simple inverter capable of powering fluorescent tubes of up to say, 10 or 13 watts. In addition we

thought it desirable to use existing transformers, if at all possible, thus keeping cost to a minimum. From this, the possibility of using a standard power transformer suggested itself as a convenient means of deriving the required high voltage.

The main requirement of such a transformer is a suitable low voltage centre-tapped secondary which, when



Above is a top view of the low power inverter clearly showing the positions of all components, including the feedback resistors. All resistors have been generously rated in order to keep operating temperature to a minimum.

the transformer is used back-to-front, can become the excited winding; the required high voltage is then generated across the original primary winding. However, an immediate deficiency of such a transformer is the lack of suitable feedback windings.

As a result, cross-coupled resistive feedback from the transistor collectors must be used, in a configuration recognisable as an astable multivibrator. The running frequency of the multivibrator will be dependent somewhat randomly on the characteristics of the particular transformer used and the load which is placed across the high voltage winding.

With completely symmetrical components, such a multivibrator configuration would be balanced and oscillation would not occur spontaneously. However, by reason of the differences in transistor characteristics, resistor values and transformer saturation, the circuit can be relied upon to oscillate.

For the low power inverter shown in figure 1, we selected a step-down transformer, A&R type 2155, having multiple low voltage secondary taps, from 0 to 15 volts. However, almost any transformer from 240V to

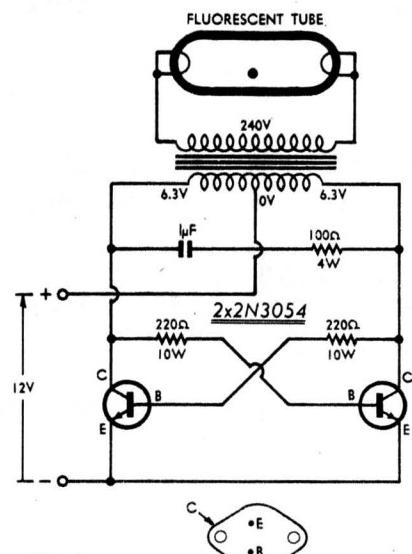


Figure 1

The circuit diagram (above) shows the relative simplicity of the low power inverter, which uses a standard voltage step-down transformer. The circuit will power tubes of up to about 13W, and requires no ballast or starting circuit.

6.3V-0-6.3 V may be used in this configuration.

The low voltage taps on the A&R transformer are labelled as follows: 0, 6.3V, 7.5V, 8.5V, 9.5V, 12.6V and 15V. The necessary centre-tapped primary is formed by connecting the 6.3V tap (the centre tap) to the positive supply and the 0 and 12.6V taps to the transistor collectors.

It will be apparent that the actual voltage impressed across each half of the primary winding will be the supply voltage minus the saturation voltage of the transistors, something less than 0.25V. Thus each 6.3V winding will be supplied with about 12V, tending to produce a good deal more than the nominal 240V "primary" voltage. There is a good reason for operating the transformer in this fashion.

Normal domestic fluorescent lighting fixtures, operating from the AC power mains, use a starting circuit to pre-heat the filaments. This is not a very practical arrangement, when operating from an inverter, because circuitry designed to cope economically with the normal operating requirements of a tube, cannot readily cope with the temporary but heavy drain of a normal starting circuit. Inverters are therefore normally designed to apply a voltage across the tube sufficient to ionise the gas spontaneously.

For the low power tubes, the cold-filament starting voltage is typically around 700V—with a sustaining voltage, after ionisation, of about 100V. A nominal 240V RMS would clearly not be sufficient to ionise such a tube but the unloaded peak-peak voltage of the inverter, as shown, is in excess of 800V.

Prior to starting, the fluorescent

the filaments prevented the inverter developing sufficient output voltage for even this mode.

However, the approach would be suitable for supplying 240V for other than fluorescent lighting and not critical as to frequency. By the addition of rectifying and filtering circuitry, such a circuit could also provide useful DC to DC conversion for mobile radio and other such applications.

But, for the present application, we

voltage of the transistor/diode combination becomes 110V.

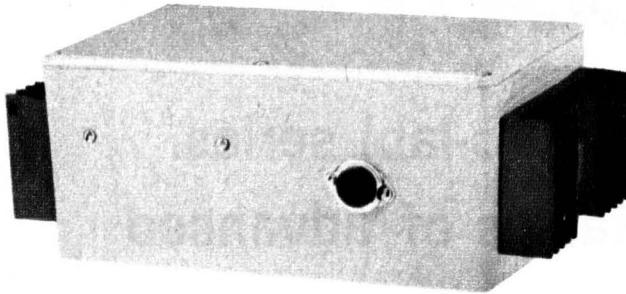
In the low power inverter, using the transformer specified, diode protection was not necessary, though the use of other transformers could necessitate the addition of protection diodes.

Protection against collector to emitter voltage-breakdown is provided in both circuits, by means of an R/C damping circuit connected across the low voltage transformer-winding. Plas-

tic capacitors were used in this network; polarised electrolytics are not suitable.

With the components specified, the higher power inverter will start with the cold filament of a 25 watt incandescent lamp as a load. With transformers having less leakage inductance, or under conditions of increased loading, the damping may be reduced or removed entirely—provided it does not

(Continued on page 87)



An exterior view of the diecast metal box housing the high power inverter is shown above. Note the mounting of the heat radiators at the ends of the case, and the four-pin input/output socket at the side.

required a transformer that would supply sufficient starting voltage. Ultimately we settled for a universal vibrator transformer, intended for use in either a 6 or 12-volt system, Ferguson type VT254.

This time-honoured transformer has a centre-tapped primary with either 6 or 12 volts per side and a centre-tapped secondary of about 250V per side. Because of the peculiar design characteristics of vibrator transformers, the voltage spikes appearing at the secondary, using the 12V primary, were more than sufficient to fire the fluorescent tubes.

Having a transformer with alternative input voltages obviously suggests the possibility of making a 6V inverter. For a given power output the primary current will be increased at the lower working voltage, while the higher relative voltage drop across the transistors must adversely affect the overall efficiency. Because of these factors and the waning popularity of 6V DC supplies, we did not carry out any practical work on a 6V unit. However, readers may care to investigate this possibility for themselves.

The circuit of the higher power inverter is relatively straightforward and in principle is the same as the smaller unit. Power switching is performed by the BDY20 transistors, which have a maximum emitter current rating of 5 amps.

In order to reduce dissipation in the cross-coupled feedback resistors, additional current amplification is obtained by means of the 40361 transistors connected in a Darlington configuration; Consequently the feedback resistors are half watt units.

With silicon transistors of the type used in the inverters, the reverse base to emitter breakdown voltage is usually of the order of 5V. Because of the possibility of a negative spike of more than 5V appearing at the base of the Darlington pair we have included diode protection in series with the bases. The diodes have a reverse breakdown voltage of the order of 100V so that the effective breakdown

At right is the circuit diagram of the higher power inverter suitable for driving tubes of up to about 25 watts. Note the alternative configurations of fluorescent tubes.

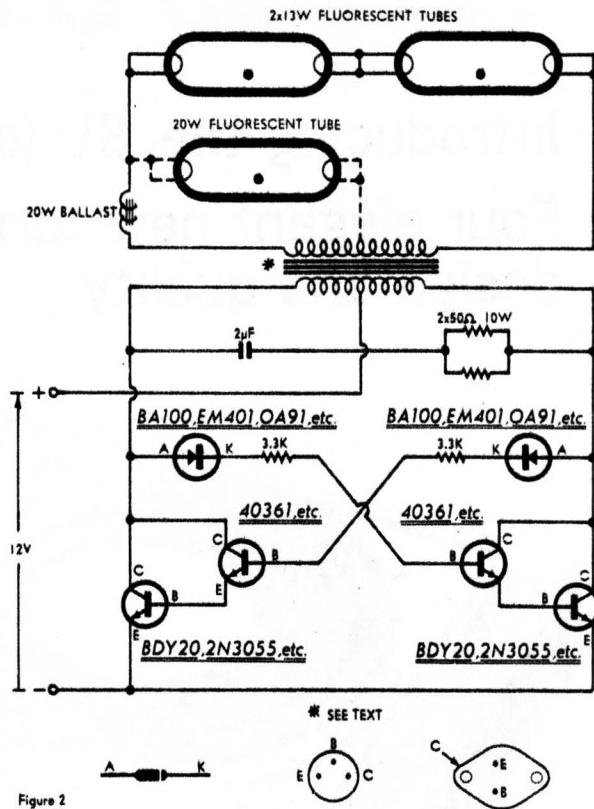


Figure 2

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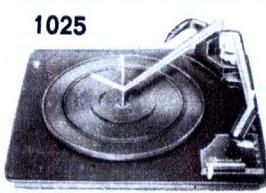
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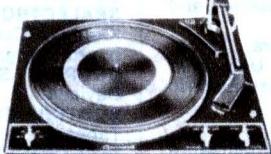
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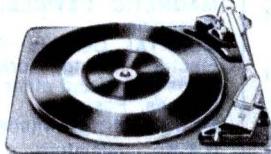
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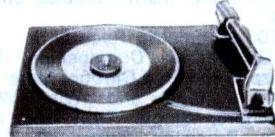
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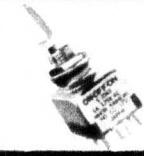
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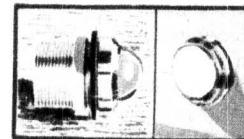
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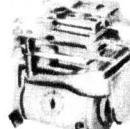
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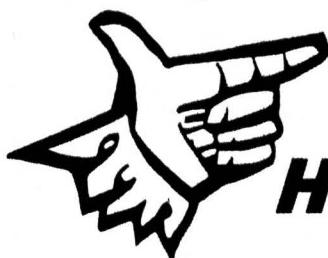
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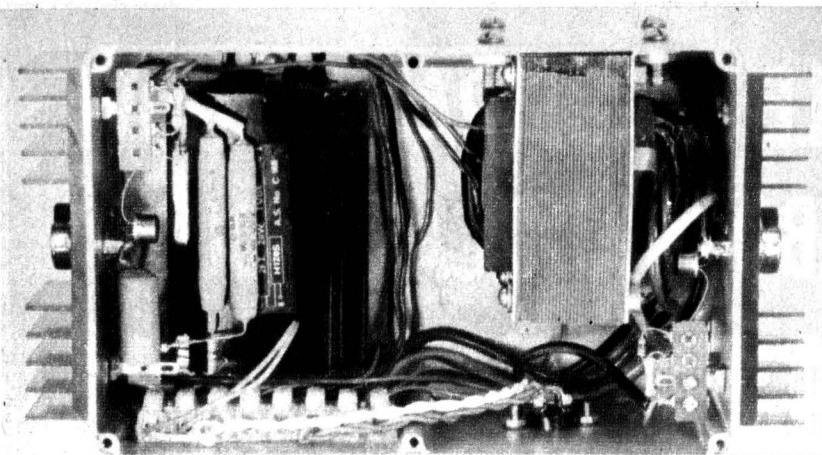
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IRH G3



An interior view of the second inverter. Note the positioning of the smaller transistors which have their base lead only secured to the tag strip, emitter and collector leads being wired directly to the larger power transistor leads.

allow the collector to emitter voltage rating (60V) to be exceeded, under no-load conditions.

The ability of the inverter to begin oscillating at switch-on will be limited by damping across the primary circuit and loading across the secondary. The more damping there needs to be on the primary, to limit voltage spikes, the less tolerant will the inverter be of secondary loading; in this respect the two quantities are related.

The nature of the secondary load also has a bearing on circuit behaviour—whether the load is predominantly resistive, capacitive or inductive, or whether it involves a rectifying system, as in a DC/DC inverter. In practice, if the circuit is part of a DC to DC converter, the primary damping can be greatly reduced or even removed entirely, consistent with proper transistor protection. However, with a load that includes the inductance of a fluorescent lamp ballast, damping will normally be necessary.

The damping resistors specified for the high power inverter are generously rated in terms of wattage, as before to limit surface temperature.

In the circuit of figure 2, alternative load configurations are shown. We suggest that the load be comprised of two Atlas 13 watt tubes, for maximum efficiency. They can be used either in separate locations or together on one fixture.

Other combinations of tubes in series are quite permissible, providing the ballast rating is approximately the same as the total power rating of the series-connected tubes. An alternative lamp arrangement is a single 20-watt tube connected across half of the secondary winding.

Construction of the smaller inverter is quite straight-forward, and consists of no more than a "U" shaped bracket. The transformer is mounted inside the bracket, the sides of which provide a suitable heat-sink mount for the respective transistors. As may be seen from the photograph, the remaining components are also mounted inside the bracket.

The 10 watt feedback resistors are wired directly to the appropriate transistor connections, while the damping-circuit components are wired across the transformer terminal board. An

additional lug had to be provided on the terminal board to retain the common ends of the resistor and capacitor in the damping network.

As a word of warning regarding the use of the smaller inverter: An audible tone produced by the vibration of transformer laminations may cause considerable annoyance to people in close proximity. We suggest that the unit be mounted with the battery, both to reduce the length of the low voltage leads and to isolate the audible tone.

The actual frequency of the tone will be determined by the particular transformer used, and the extent to which it is loaded. With the components specified, the lower power inverter oscillates at about 300Hz while the higher power inverter operates at about 400Hz. The frequencies given are merely a guide and will vary from unit to unit.

The mechanical aspects of the higher power inverter are a little more elaborate, involving the use of finned heat radiators and a diecast metal box. However, the method of construction illustrated is merely a suggestion and is by no means mandatory.

The agent for the diecast metal box and lid, is Standard Telephones and Cables Pty. Ltd. Finned transistor heat sinks attached to the end of the box are also commercial units, manufactured by Ferris Brothers Pty. Ltd. Both the case and the radiators are readily available from trade suppliers.

As may be seen in the photograph, both the transformer and ballast choke are mounted in the box, their leads being terminated at a strip of plastic "BB" terminal blocks. A four-pin plug and socket is provided for input and output voltage connections.

The two 3.3K resistors and two diodes are mounted on 4-lug miniature tag strips which are retained by the heat sink retaining screws. Collector and emitter leads of the two low-power transistors are connected directly to the appropriate leads on the two power transistors, while the remaining base leads are wired to the adjacent tag strips.

The power transistors are mounted to the finned heat sinks in the usual manner, using mica washers, insulating bushes and silicone grease. However,

large holes must be drilled in the side of the diecast box to allow clearance for the transistor mounting nuts and the collector-connecting solder lug, in addition to the emitter and base leads.

With the second inverter, there is no lamination noise from the vibrator transformer, but there is a tendency for the ballast choke to "sing." However, with the lid of the box screwed in place there is no audible noise of any consequence.

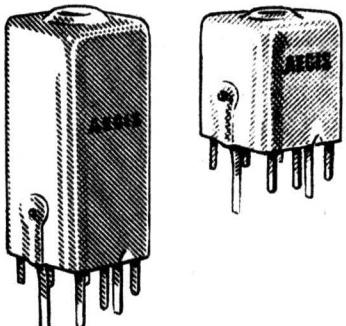
However, we still suggest that the unit be mounted close to the battery supply, if only to reduce power losses in the low voltage leads.

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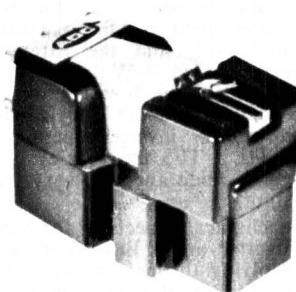
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AUDIO TOPICS

Test Record from Festival

Test records, which are released from time to time by the distributing companies, provide enthusiasts with the opportunity of assessing the performance of their stereo systems. This new Project 3 disc has specific checks for channel balance and phasing, overall frequency response, high and low-frequency tracking ability, glide-tone to search out room rattles, and a silent track to show up hum and rumble. This, in addition to musical phrases.

TESTING 1, 2, 3, 4. Stereo Test Record, presented by Enoch Light. Project 3 (Festival) SPJL-932,865.

Issued originally in America in conjunction with "Popular Science" magazine, Enoch Light's new Project 3 test record has been released in this country by Festival Records Pty. Ltd. While it may have a limited application in a laboratory situation, it is intended primarily for use by hi-fi fans in the home listening room.

Band 1, side 1 contains an introduction to the record by NBC announcer Peter Roberts whose voice emerges strongly from the centre "phantom" channel. In band 2, voice and then tone emerge from the left loudspeaker, then from the right—the kind of track that is always handy to have available.

The phasing test on band 3 involves a low frequency tone, with the advice to interchange the leads to one loudspeaker and select the connection which gives the loudest output. It is unfortunate that the script does not also suggest putting the speakers face to face with just a narrow V towards the listener; then the difference can really be heard.

Band 4 is a 1000Hz tone which should appear to come from between the loudspeakers if the channels are now correctly phased and balanced; this provides a specific opportunity to adjust the balance control.

An explanation of frequency response occupies band 5, while the actual test tone tracks follow in band 6. The possibility is suggested of measuring electrical output from the amplifiers with a suitable AC voltmeter but the individual test tones from 10KHz to 30Hz are rather brief and interspersed with quite loud announcements—neither of them desirable features for metering purposes. For straight listening evaluation, however, they serve the purpose quite well.

The following bands provide tracking tests, with recordings of a glockenspiel and a bass drum for high and low frequencies, each at four different recording levels. There is a glide tone

track to show up buzzes and rattles in the listening room, silent grooves to provide a check for motor rumble and an A-440 track, presumably to serve as a musical reference.

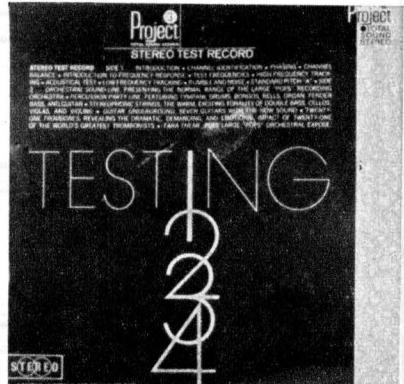
Side 2 is devoted mainly to musical tones, phrases and excerpts intended to emphasise and reveal the strengths or the weaknesses of the equipment as a whole. These have a strong Enoch Light "pop" flavour and are open to some criticism in that they make frequent use of amplified instruments, leading to the dubious situation of listening to amplifiers on amplifiers! However, whether amplified or acoustic, the instruments are all recorded without trace of distortion or overload.



Bobby Hackett—trumpet



Joseph Iadone—guitar



Tucked away in one corner of the literature supplied to us with the record were technical notes which nominate the equipment used to make the recording, and details of the tracking tests mentioned earlier. The high frequency tracking test involves stylus velocities in excess of 25cm/sec while the bass drum tracking tests called for a pitch as low as 12½ lines per inch. It is, in fact, the coarsest pitch I have yet seen on microgroove.

I am pleased to say that my own review gear, with the cartridge tracking at not more than 1gm, played through the whole thing without incident or apparent stress.

The notes on the back of jacket are mainly a eulogy of the Project 3 system but a separate leaflet which comes with the disc gives more of the technical background. (W.N.W.).

Festival point out that the test recording is one of a group of high performance discs which have just been released from the Project 3 studio.

THE FREE DESIGN. Kites Are Fun. Festival stereo SPJL-932,876. Also mono PJL-32,876.

FASCINATION. Stan Freeman, His Piano and Orchestra. Festival stereo SPJL-932,648.

MUSIC FOR WEIGHT WATCHERS. Mel Davis and the Ricky Ticky Brass. Festival stereo SPJL-932,824. Also mono PJL-32,824.

LUSH, LATIN AND LOVELY. Tony Mottola, guitar. Festival stereo SPJL-932,825. Also mono PJL-32,825.

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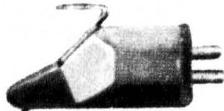
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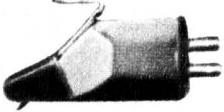
Empire 888TE cartridge for high-quality turntables and record changers. With a vertical and horizontal compliance of 25×10^{-6} cm/dyne, this outstanding cartridge delivers a frequency response of 6 to 32,000 Hz in top-quality changers and tone arms tracking at 2 grams or less. The .2 x .7 mil bi-radial elliptical diamond stylus tracks at 15° with more than 30 dB of channel separation. Output voltage, 8 millivolts per channel. Weight, 7 grams. Mounts on standard 7/16 and 1/4in centres, with four terminals.

888E



888E cartridge for most of today's better record changers and automatic systems. Designed to track at 3 grams or less, this cartridge provides users of automatic changers with the superior performance of a .4 x .9 mil elliptical diamond tracking at an angle of 15°. The 888E will faithfully reproduce frequencies from 10 to 30,000 Hz, while maintaining more than 30 dB of channel separation. Weight, 7 grams. Output voltage, 8 millivolts per channel. Compliance, 12×10^{-6} cm/dyne. Four terminal output with standard 7/16 and 1/4in mounting centres.

888



888 cartridge for general record changers. Changers requiring a tracking force of up to 4 grams will deliver superior performance when equipped with this fine cartridge. A .7 mil diamond stylus tracking at 15° delivers a frequency response from 12 to 25,000 Hz, with 30 dB channel separation. Vertical and horizontal compliance, 10×10^{-6} cm/dyne. Weight, 7 grams. 4 output terminals and standard 7/16 and 1/4in mounting.

808E



808E—Perfectly adapted to automatic playback systems able to track at less than 3 grams, this superior cartridge combines a compliance of 12×10^{-6} cm/dyne with a frequency response of 10 to 25,000 Hz and utilises a .4 x .9 mil elliptical diamond set at the preferred 15° angle. Stereo separation exceeds 30 dB. Weight, 7 grams. Mounting, 7/16 and 1/4in centres. Output terminals, 4.

808



808—Capable of delivering 10 to 20,000 Hz with 30 dB of stereo separation, the 808 is an outstanding cartridge value for those with automatic changers requiring tracking forces up to 4 grams. Compliance is 8×10^{-6} cm/dyne, and the 7-gram cartridge employs a .7 mil conical diamond stylus tracking at 15°. 4 output terminals and standard 7/16 and 1/4in mounting.

The new Armstrong fully transistorised integrated tuner/amplifiers AM/FM and stereo amplifiers. Models 426, 421 and 423.

SPECIFICATIONS series 400

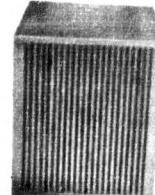
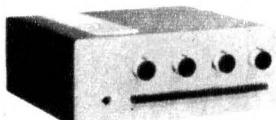
AMPLIFIER AND CONTROL UNIT

SECTIONS 421, 425, 426

RMS Power Output	15 watts per channel, 4-16 ohms
Music Power (IHF/M)	20 watts per channel, 4-16 ohms
Power Response	15 watts RMS, 20-20,000 Hz -1 dB.
Frequency Response	20-20,000 Hz \pm 1 dB
Harmonic Distortion	Less than 0.5% at 1 kHz measured at 15 watts output \pm 1 dB
Crosstalk	Better than 40 dB
Channel Matching	\pm 1 dB
Bass Control	\pm 10 dB at 70 Hz
Treble Control	\pm 10 dB at 10 kHz
Balance Control	Maximum to zero each channel
Rumble Filter	-5 dB at 30 Hz increasing at lower frequencies
Treble Filters	1. 6.5 kHz -3 dB, 10 kHz -25 dB 2. 4.5 kHz -3 dB, 9 kHz -40dB
Loudness	At 1 kHz reference (-20 dB), 70 Hz +10 dB, 10 kHz +5 dB
Tape Recording	
Output	400 mV Low impedance
Headphone Output	Suitable for all stereo phones
Inputs	Sensitivity Hum & Noise (reference 15W)
Tape Playback	400 mV -70 dB
Radio (421 only)	100 mV -60 dB
Pickup 1. Ceramic	60 mV -55 dB
Pickup 2. Magnetic	3.5 mV -55 dB

AM TUNER SECTION 423, 428

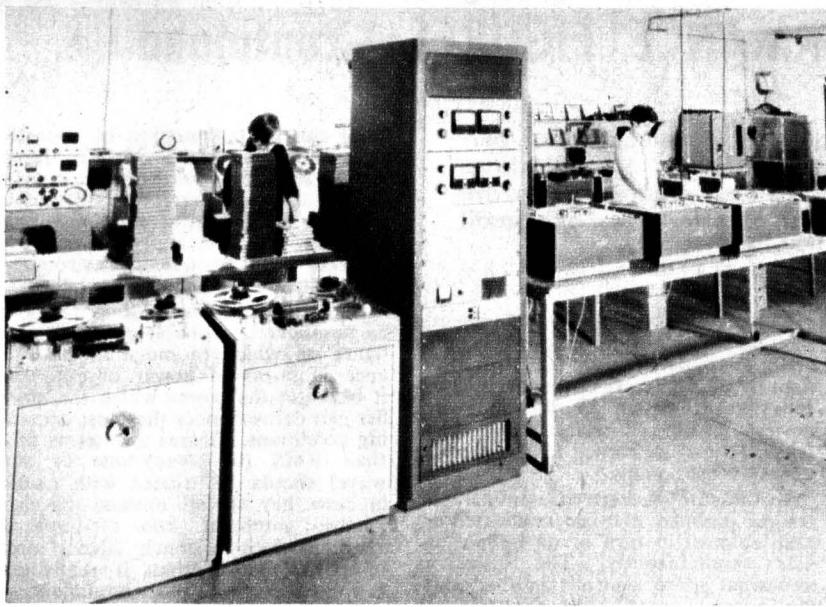
Coverage	Medium waveband 185-590 metres; 510-1,625 kHz Long waveband 1,000-2,000 metres; 150-300 kHz
Sensitivity	5 μ V for 20 dB quieting
Intermediate Frequency	430 kHz
IF Bandwidth	4 kHz at 6 dB down
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ASTOR CASSETTE TAPE FACILITIES

Equipment that will simultaneously "dub" both forward and return paths on a 0.15in music cassette tape in less than two minutes—at 16 times the speed at which the tape is subsequently operated on cassette players—has been installed by the recording division of Electronic Industries Limited.

The equipment is claimed to be the fastest in the world and was manufactured by Ampex Corporation of Redwood City, California, one of the biggest suppliers of recording and highly specialised space equipment. It is only the third such equipment that Ampex has produced to date; the other two are in operation in leading American recording plants.

With the installation of its new equipment Electronic Industries becomes the first Australian company to produce cassette players in their entirety and to make and pre-record music cassettes for use with the players. The only component not manufactured in its own plant is the raw tape.

The company commenced production of play-back equipment, initially for use in cars, in October last and the general manager of its recording division, Mr Neville Smith, said recently that the demand had been far in excess of expectations in all States. Pending receipt of its Ampex pre-recording equipment it has used tape that has been dubbed to its requirements overseas.

Despite the remarkable speed with which the new equipment operates it gives exceptional quality of reproduction, Mr Smith said. It has a frequency response of from 40Hz to 12KHz at 1-7/8 inches per second.

The equipment currently comprises two master reproducers, a master control rack and three slave duplicators. The latter enable three cassette tapes to be dubbed at the one time and their potential output is between 500 and

700 cassette tapes a day. A further seven slave duplicators can be added as required, more than trebling this potential.

Once the master reproducer units are set up and each duplicating unit is fed with the 3,600 feet lengths of raw tape, the operation is completely automatic. When removed from the duplicators the 3,600 foot lengths of pre-recorded tape go to a tailoring department for cutting to correct lengths.

The dubbed tapes are four-track stereo and play at 1-7/8 inches per second. In addition to the music cassettes, which are marketed as "Musicassette," Electronic Industries is producing pre-recorded high fidelity stereo 1in tape on 7in open reels to play at 7½ips and mono 1in tapes on 5in open reels to play at 3½ips, both on separate sets of equipment. It is also producing blank C60 Compact Cassettes for home dubbing of tape.

The company's dubbing complex and its conventional record-producing plant have expanded so greatly in recent months that the preparation of plans for a new air-conditioned 13,000 square foot factory at Astor Centre, Clarinda, has been necessary. The new factory is scheduled for completion by the end of the year.

Mr Smith anticipates that within the next five years the sale of taped music will equal the sale of conventional records. This is already the trend overseas. Sixty-six titles have so far been produced in cassette form by Electronic Industries for sale under its Astor brand name, and regular releases are planned for the future.

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AMPLIFIER PERFORMANCE FIGURES—continued

Continued from last month, this article on equipment performance deals particularly with the power output ratings of amplifier systems. It warns against figures which are sometimes published in an apparent effort to make small amplifiers look big!

Having taken a closer and a quantitative look at distortion, we are in a better position to define more precisely the likely requirements of an amplifier in terms of power output.

Power output is normally expressed in watts (abbreviated to W) the figure indicating the amount of audio power which an amplifier can deliver to its intended load (normally a loudspeaker system) without introducing an unacceptable level of distortion. This is sometimes referred to as the undistorted power output, a term which is admittedly somewhat idealistic, though commonly used nevertheless.

The procedure for measuring power output involves connecting across the output terminals of the amplifier a resistor equal to the value specified as the optimum load for the amplifier; it should be within 5 per cent (or better) of its marked value and rated to withstand a wattage in excess of the anticipated power output. To take a typical case, if an amplifier is expected to deliver 10 to 12 watts of power into an 8-ohm load, a suitable load resistor for a power output test would be one within a value range no wider than 7.6 to 8.4 ohms (± 5 p.c.) and rated to dissipate 20 watts.

To measure the voltage developed across this load resistor an AC voltmeter is normally required, of reasonably high internal impedance (100 ohms or more per volt) and accurate to within 2 per cent of the scale reading at the signal frequency involved.

A cathode-ray oscilloscope is also necessary, or other means of observing the distortion level. An oscilloscope can also serve as the AC voltmeter if it is calibrated for voltage amplitude to the required order of accuracy.

A pure sine-wave signal is fed to the input of the amplifier (at 1000Hz unless otherwise specified) and the signal level advanced until any kind of departure from a pure sine wave is discerned on the screen of the oscilloscope. The signal level is then reduced again until the distortion just disappears. Alternatively, the signal level may be advanced until the distortion level reaches some selected figure, as read on a distortion factor meter.

At this point, with the amplifier on the verge of overload, the AC signal voltage across the load may be read and the power output obtained by the following formula:

$$P = \frac{E^2}{R}$$

where P is the power output in watts, E is the RMS signal voltage as read on a conventional AC meter, and R is the resistance of the load in ohms. The accuracy of the figure so obtained will obviously depend on the accuracy of the resistor, of the voltmeter and the care with which the amplifier is set to the verge of overload.

The figure so obtained is frequently referred to as the RMS power output of the amplifier; occasionally and alternatively, it is described as the steady-tone power output or the sine-wave power output, all terms which have fairly obvious reference to the method of taking the reading.

In the case of a stereo amplifier, the test as outlined may be conducted on each channel in turn or on both channels simultaneously. The latter is somewhat more rigorous in that, during normal usage, both channels are being driven by music signal and both are imposing a near maximum load on the common power supply.

The accompanying curve will serve to illustrate some of these points; it is a straightforward plot of total harmonic distortion (THD) against power output for one channel of a modern stereo power amplifier. The curve indicates that the THD remains at or below 0.1 per cent up to a power output level of 20 watts RMS; it then begins to rise fairly steeply, reaching 0.15 per cent at 25 watts and 0.25 per cent at 30 watts. This last is the figure which the manufacturer has arbitrarily—and rather conservatively—nominated as the rated power output of the particular amplifier. Had the manufacturer elected to set a higher distortion limit or relied

there can be no question of operating an amplifier into the overload region in any situation where fidelity is at all important. It is therefore vital that an amplifier have adequate power output to meet any anticipated demands in the particular listening environment. We shall say more about this, later.

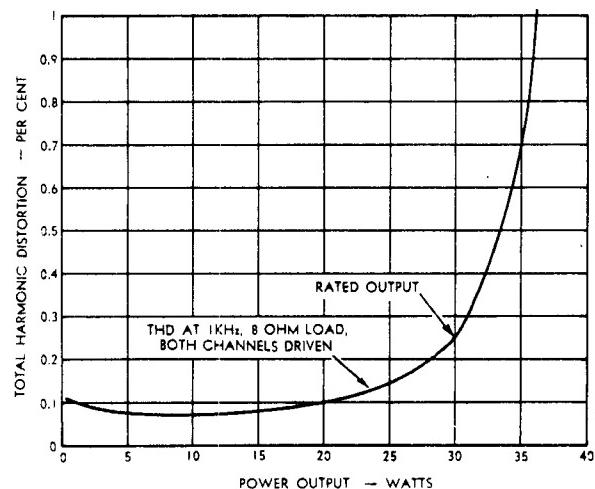
The RMS or steady-tone rating of an amplifier is probably the best single figure on which to judge its performance in terms of power output, since it indicates the power which the amplifier can deliver under the most demanding conditions. Figures and terms other than RMS (or steady-tone or sine-wave) should be treated with caution in case they should mislead the prospective purchaser into crediting an amplifier with a much higher order of power output than it really has, in comparison with other amplifiers.

Some of the methods of describing power output stem from the fact that many amplifiers are able to deliver rather more "undistorted" power on isolated peaks of speech and music than they can on sustained sine-wave input.

In pursuance of this, various methods have been adopted to derive power output ratings related to program rather than steady-tone input and, without going into a lot of detail, these have resulted in figures for such quantities as music power output, IHF power (Institute of High Fidelity) or EIA power (Electronic Industries Association). See also "AF Tone Burst Testing," Electronics Australia, April, 1968.

Power output quoted on one or other of these (or comparable) bases may typically exceed the RMS power for

While the distortion level in a modern amplifier can be gratifyingly low over its normal working range, the rise in distortion is abrupt and extensive once the non-linear region is reached. An amplifier operated into its overload region can therefore introduce severe distortion, intolerable in any situation where quality is important.



upon a level determined visually on an oscilloscope, he could fairly have claimed a higher power output.

Details aside, however, the curve does indicate a behaviour pattern which is common to most power amplifiers, namely that, as they are driven into the region where non-linearity becomes evident, the level of harmonic (and intermodulation) distortion rises quite steeply; the amplifier is said then to be running into overload.

In fact, the distortion tends to rise so steeply and to such a level that

a given amplifier by factors varying as widely as 1.1 to 1.5 but grouping mainly in the region 1.2 to 1.3. On this basis, an amplifier capable of delivering 10 watts RMS might typically be quoted as capable of the more flattering figure 13 watts music power—or IHF or EIA power.

As distinct from music power and IHF and EIA ratings, which at least have a responsible basis, some manufacturers and vendors have resorted to the highly questionable practice of crediting amplifiers with so many watts

of peak power output. This figure is obtained by using the peak value of the AC voltage in the power formula mentioned earlier. Since this is 1.4 times the RMS voltage, the figure obtained for power output is twice the RMS power output. Thus a small amplifier with an RMS power output of 5 watts may be advertised as capable of delivering 10 watts of peak power—a figure that is as misleading as it is impressive!

In an everyday situation, it would be equivalent to branding a 100-watt electric light globe as 200-watt on the basis that it draws something like 200 watts on the peak of the AC cycle!

Not content with this device some have branded amplifiers on the basis of peak output during a musical transient, giving rise to the term peak music power.

Assuming a stereo system, the figures for the two channels can also be added to produce total peak music power, yielding a most impressive figure for what might be a very unpretentious amplifier.

Thus, a 5 plus 5 watt RMS stereo amplifier might conceivably yield 6.5 plus 6.5 watt music power. Taking peak voltage as a basis, this would jump to 13 plus 13 watt peak music power. Add the two and the same amplifier becomes a unit rated at 26 watts total music power!

While it is fairly common practice in sales literature to quote "flattering" figures for power output, such figures are regarded with a good deal of reservation in technical circles.

A sound approach is to pay attention first to the RMS power rating, eliminating from further consideration amplifiers which do not meet a predetermined figure. This will provide some assurance that the system will be able to cope with loud, sustained tones, which invoke conditions not unlike the sine-wave test. Note can then be taken of whether any of the amplifiers which qualify in terms of RMS power, have a distinct advantage in music power.

To quote some typical figures of power output, the smallest equipment in current use, such as portable receivers, have an RMS power output of a few tenths of a watt. This is enough for personal listening but the audio amplifier in such receivers rapidly runs into gross overload if the volume is advanced in an effort to compete with surrounding noises—as in trains and cars. In such equipment the limitation on power is imposed not only by small physical size of the unit but also by the amount of operating current which can reasonably be drawn from the internal batteries.

From such a figure, the order of power output ranges up to 3 to 5 watts RMS for mains-powered portable players or per channel for domestic stereograms. This ensures an adequate level of "undistorted" sound for ordinary homes, assuming the use of normally sensitive loudspeakers.

It would be too difficult just here to give a quantitative definition of the word "sensitive" but it refers to the comparative efficiency with which a particular type of loudspeaker can translate electrical drive into acoustic output. The majority of routine 6-inch to 12-inch diameter loudspeakers exhibit average efficiency and sensitivity but there are those which, for

various reasons, are above or below this average.)

The same 3 to 5-watt figure per channel may be reckoned adequate for an amplifier system intended for modest—though still pleasant—listening in a quiet home. However, such an amplifier may easily be pushed to its overload region if:

1. The listener likes his or her music at louder than ordinary level; or
2. The amplifier is used in conjunction with loudspeakers which exhibit less than average sensitivity; or
3. The amplifier is used with control facilities that artificially boost the power requirements at low (i.e. bass) frequencies.

All things considered, a figure of 10 watts RMS per channel can be regarded as a minimum, though adequate, figure for a good quality stereo system for use in the average suburban home. If an amplifier is available with more power output than this, it will have a greater reserve of power for isolated, loud music peaks or for the odd occasion when the owner wants to show off! However, even on this basis it is hard to justify more than 25 watts per channel and amplifiers boasting still higher power would be unlikely to confer any practical advantage. There may even be a disadvantage in that residual hum and noise could be more of a problem than from amplifiers scaled more closely to actual needs.

While the output rating of an amplifier indicates how much audio power it can deliver to a loudspeaker system, the figure is meaningful only if the amplifier has enough overall amplification or gain to raise the original input signal to this power level. Using other terminology, which was men-

tioned earlier, the amplifier must be sensitive enough or have enough sensitivity to operate from the available signal.

In practice, it is usual and convenient to arrange matters so that the amplifier has two or three times the amplification or sensitivity necessary to operate in conjunction with the anticipated signal source—pickup, radio tuner, etc. This means that the volume control, which really varies the effective gain of the amplifier, will normally be operated up to about half on, in terms of its physical rotation. The remainder of its travel is available to cope with input signals which, for one reason or another, are below average level.

If the gain or sensitivity of an amplifier system falls significantly short of the anticipated requirement, the amplifier will not produce its full rated power, even with the volume control fully advanced. On the other hand, if the gain or sensitivity is far in excess of requirements, the sound from the loudspeakers will range from zero to full available power for an inconveniently small amount of volume control rotation. In addition, there is the danger that the input stages of the amplifier may be driven into non-linear distortion by an excessive input voltage, irrespective of the setting of the volume control.

Present-day stereo amplifier systems commonly have provision to take their input signals from magnetic gramophone pickups, ceramic gramophone pickups, tape players and radio tuners; many have a "spare" input channel as well. In terms of sensitivity, typical figures are as follows:

MAGNETIC PICKUPS: About 3 millivolts input for full output. In addition to providing the high order of overall amplification which this represents, the amplifier should also provide the frequency compensation necessary for all magnetic pickups, involving (in round figures) about 15dB of bass boost and 10dB of treble cut. Ideally, the input impedance—or the impedance which the amplifier input places across the pickup—should be not less than 50,000 ohms.

CERAMIC PICKUPS: About 70 millivolts input for full output but without the need for extensive frequency compensation. Input impedance should be 2.0 megohms. The same input can normally be used for the older "crystal" pickups.

TAPE SYSTEM: The amplifier may be designed to take the signal directly from the replay head, in which case the sensitivity needs to be of a similar order to that for magnetic pickups. However, the compensation needs to provide still more bass boost, the treble being either level or somewhat boosted. Input impedance, typically 0.1 megohm.

Alternatively, the amplifier may be designed to take its signal from the "auxiliary output" jack of a normal tape recorder, in which case no frequency compensation should be necessary and an input sensitivity of between 100 and 200 millivolts will suffice. Input impedance, typically 0.25 megohm.

RADIO TUNER: Typically 100 millivolts input for full output, no frequency compensation. Input impedance 0.25 megohm or higher.

SPARE CHANNEL: Same specification as for radio input.

POWER RATING OF LOUDSPEAKER SYSTEMS

The power handling capacity of a loudspeaker is based partly on rising distortion content and partly on what the manufacturer considers the unit will reasonably handle without suffering physical damage to the cone and/or suspension system. The rating is heavily dependent in practice on the nature of the baffle or enclosure on which the loudspeaker is mounted. It should be regarded as a guide figure, therefore, rather than a rigid limit.

For good quality sound in the home, a loudspeaker system should ideally have a nominal power rating of 10 watts RMS or greater. In fact, the higher the rating, the less the system will be stressed.

A power amplifier may have a rating in excess of the loudspeaker used with it provided the amplifier volume control is not advanced carelessly or recklessly to drive the loudspeakers beyond what is an appropriate level. Thus a pair of, say, 10-watt loudspeaker systems could be used quite reasonably in a home with a twin 25-watt stereo amplifier provided the playing level was kept within bounds commensurate with normal home listening.

KITS

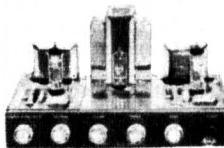
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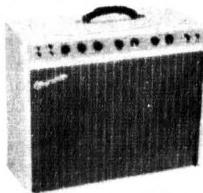
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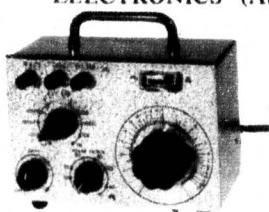
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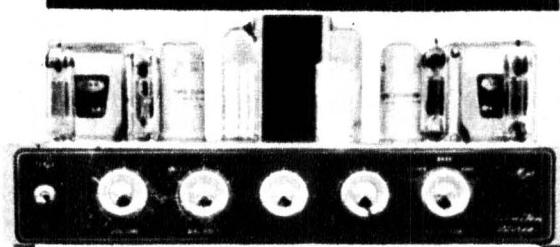


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Classical reviews

By JULIAN RUSSELL

Mozart . . . "enchanting performance"

MOZART—Violin Concerto No. 3 in G Major (K.216). Isaac Stern and the Cleveland Orchestra conducted by George Szell.

Sinfonia Concertante in E Flat Major for Violin, Viola and Orchestra (K.364). Walter Trampler (viola) and Isaac Stern playing and conducting the London Symphony Orchestra. CBS Stereo SBR235258.

I think I could pick Isaac Stern's tone from that of a dozen other fiddle players. It is unforced yet vibrant, expressive without sentimentality. And he uses it to perfection in this delectable recording of what is probably Mozart's most popular violin concerto. The first movement is taken as amiably as possible, but avoids being ingratiating. And, as might be expected, Szell and his peerless orchestra provide an exemplary accompaniment.

In the slow movement the whole mood, even the colour of the orchestra, changes. Everything is warmer and both soloist and orchestra play with limpid beauty of tone I have never heard matched in the many fine recordings that exist of the work. The Finale dances as lightly as a snow-

flake—though, even here, the firmness of outline Stern and Szell use to reinforce the structure is never relaxed. An altogether enchanting performance.

The Sinfonia Concertante is not often played, and more's the pity, since it contains one of the most beautiful slow movements Mozart ever wrote. The viola and violin are not well matched partners, principally because the violin's tone has more carrying power than the viola's. This is due to the fact that, in terms of its pitch, the viola's size is a compromise. It should be bigger to utter its deeper pitched notes but, if it were, the player couldn't put it under his chin, and it would be too small to play it upright like a cello. With this in mind, the problem of matching the tones of the two has been effectively solved by CBS's sound engineers. On this disc both share equal partnership and responsibility.

However this was managed — by monitoring or microphone placing — there is no questioning its success. The whole work is beautifully played by both soloists—give or take an occasional intonational lapse by the viola —and the sound is of the highest fidelity consistent with unobtrusiveness.

Puccini . . . Complete "La Rondine"

Puccini—La Rondine. Complete Opera.
Anna Moffo (Magda); Daniele Barioni (Ruggero); Mario Sereni (Rambaldo); Graziella Sciutti (Lisette); Piero de Palma (Prunier) RCA Italiana Opera Orchestra and Chorus conducted by Francesco Molinari Pradelli. RCA Stereo LSC8004/5.

La Rondine has had a curious history. Although it was written by the most popular opera composer of the day it never really got off the ground. Early in 1914 two Viennese entrepreneurs commissioned Puccini to write a light, operetta-type work using the formula of about eight or 10 good songs separated by dialogue, some of it spoken, some of it sung, in the manner of "Fledermaus" or similar confections. A good deal of haggling went on about the price to be paid Puccini but at last an agreement was reached and he set to work.

While Puccini was engaged on the usual protracted discussions with his librettists — for he always knew what he wanted in the way of a script and frequently rejected what was offered

him—World War I broke out. This meant that Austria and Italy were on opposite sides and, since Puccini went on working on the score, he was accused of being unpatriotic in preparing an opera to be premiered in Vienna. However, Puccini completed the score by about the end of 1916 and, since a premiere in Vienna was out of the question, it was put on for the first time in Monte Carlo in 1917. It was received with indifference and none of the other opera houses showed any interest in it. When it was offered to Covent Garden it was rejected on the grounds that it was not suited to English tastes.

New York showed a similar lack of interest. This is amazing when one recalls that Puccini had behind him at that time such firm world-wide favourites as "La Boheme," "Butterfly" and "Tosca" with "Manon Lescaut" still aired from time to time. Even Puccini's regular publisher and old friend, Tito Ricordi, would have nothing to do with what he described as "bad Lehár." So it remained on the shelf for over half a century until RCA had the happy idea of recording it.

I attribute its lack of success to some stretches of fairly uninteresting recitative and the absence of any arias which, performed on the concert platform, might have raised interest in the work away from the opera house.

But these shortcomings are more than atoned for by the stream of really beautiful melodies — plus a few ordinary ones — that delight the ear even at first hearing.

The story is simple but effective. Magda, a kept woman with friends of her old Bohemian days and rich suitors filling her salon rather in the manner of Violetta's in "La Traviata," meets and falls in love with an ardent but inexperienced young man from the country. Magda decides to give up her life of luxury and sets up an establishment with him in the south of France. Her lover, Ruggero, wants to marry her and writes to his mother asking her permission. This she grants since she thinks Magda is a pure girl. But Magda, with her past, realises that she could never live up to this pretence and in a final duet sends Ruggero away, though she loves him more than ever.

There is much animated conversational writing such as you find in the first act of "Manon Lescaut" and the second act of "Bohème." But by then Puccini's technique was much more assured than in the earlier works, his orchestration more resourceful, his harmonies richer and his treatment of the voice unimpaired. In Act 2, a ballroom at a fashionable Paris restaurant, one is reminded a little of the Cafe Mumus scene in Bohème, but here Puccini, with a Viennese audience in mind, introduces Viennese waltzes, fox trots, tangos and other popular dance forms of the period. Some, it must be admitted, verge on the banal but, for the most part, they are delightfully tuneful and as fresh today as when they were written over 50 years ago.

Magda is beautifully sung by Anna Moffo, Ruggero a little on the heavy side by Daniele Barioni. There are also two second-level characters, Prunier a poet (Piero De Palma) and Lisette, Magda's maid (Graziella Sciutti) who have their own love affair rather like Marcello and Musetta in Bohème. The excellent RCA Italiana Opera Chorus and Orchestra are under the firm but sympathetic direction of Molinari-Pradelli. The sound is first rate, and I think that, at long last, the work will achieve popularity, at any rate on records, if not in the opera house.

★ ★ ★
VERDI RARITIES. Arias from "Un Giorno di Regno," "I Lombardi," "I Due Foscari," "Alzira," "Attila," "Il Corsaro," "Arnoldo," Montserrat Caballe (soprano) with the RCA Italiana Opera Orchestra and Chorus conducted by Anton Guadagno. RCA Stereo LSC2995.

All these operas, so seldom heard nowadays, were written between 1840 and 1850. During the same period Verdi also composed the much better known "Nabucco," "Ernani," "Macbeth" and "Luisa Miller." If you would learn more about the rarer works the producer of the disc, Richard Mohr, has supplied some informative and witty sleeve notes on the subject. But readable as these are, they are no

substitute for a copy of the text, which does not come with the record.

Some of the arias are so beautiful that one regrets not knowing more of the scores from which they have been extracted. Even those which don't measure up to the best that Verdi could produce during this period are well worth hearing and Montserrat Caballe sings them all in a big, expressive voice, admirably controlled throughout its range if one excepts an occasional hardening of tone on a top note. Her style is operatic in the grand manner, entirely suitable to the excerpts. And she can, when necessary, use a beguiling pianissimo which I find quite irresistible.

So far as I can remember I have never heard Anton Guadagno conduct before. But if his accompaniments here are typical of his work, the loss has been mine—and perhaps yours, too. He uses the RCA Italiana Opera Company's Orchestra and Chorus with discretion toward the singer and unfailing good taste in those passages he has on his own. Don't dismiss this disc as a mere musical curiosity. It offers something altogether more enjoyable than that.

* * *

BERLIOZ — Symphonie Fantastique. Toronto Symphony Orchestra conducted by Seiji Ozawa. CBS Stereo SBR235248.

I heard the Toronto Symphony Orchestra under Ozawa in 1965 in London during the Commonwealth Festival of Arts and thought them a rather brash combination. The playing was always vivid and accurate but displayed little subtlety. I find much the same in this recording. Everything is scrubbed clean in the execution, but the first two movements lack the romantic gestures so dear to the young Berlioz who wrote the symphony. There is little that is feverish in the first movement, despite some pretty heavy underlining of phrases here and there. And the second movement, "In The Fields" paints an empty landscape picturesquely enough, but somewhat a dehumanised one.

However, when you get to the Valse you are in for some really brilliant entertainment. Again in the two final movements, "The March to the Scaffold," and the "Witches Sabbath," the full measure of Berlioz macabre imagination is realised. These two movements are faultless in conception and execution.

Taken all round, this is a good performance, if not my favourite. I think it might be advisable, if you are in the market for a "Symphonie Fantastique," to wait until EMI put out their new recording by Munch and a brand new Parisian Orchestra that has just been founded with the backing of the French Government. It should be available almost by the time this goes to press.

* * *

STRAVINSKY — Petrouchka (1947 version). Circus Polka. Los Angeles Philharmonic Orchestra conducted by Zubin Mehta. Decca Stereo SXL6324.

This is an interesting disc in the amount of detail that can be heard without effort in Stravinsky's complex

score. Whether or not this was legitimately realised I am unable to say. But you certainly hear more than you would in a theatre or concert hall of even the best acoustical design. And if, in bringing this about, the balance can be rightly described as falsified, then it is done in a way that in no way disfigures the score. Indeed I can imagine no better recording for students who wish to follow the music, score in hand.

I am less sure about the merit of the performance. Mehta's result sounds always relaxed and effortless despite the trickiness of some of the parts. And it might fairly be described as accurate throughout. But I am not always happy when I listen to his little bursts of speed for which there is no justification in the composer's markings, and his too frequent playing down of climaxes. But perhaps my objections are the result of my knowing the work primarily as an accompaniment to a ballet in which the dancers' requirements are important to tempo. By the way, a very full account of the stage action makes the music very easy to follow in relation to what is going on on the stage.

The fill is the delightfully witty little piece that Stravinsky wrote for the

American Barnum and Bailey Circus Company who wanted music to which their elephants could lumber around in what the program described as an Elephant Ballet. Here Mehta makes every point with precision and wit.

* * *

BERNSTEIN — Chichester Psalms for Chorus and Orchestra. The Camerata Singers and the New York Philharmonic Orchestra conducted by Leonard Bernstein.

Facsimile — A Choreographic Essay. New York Philharmonic Orchestra conducted by Leonard Bernstein. CBS Stereo SBR235249.

The Dean of Chichester in England commissioned Leonard Bernstein to set these psalms for performance at the Southern Cathedrals Festival in 1965. The psalms chosen were 108, verse 2; 100 complete; 23 complete; 2, verses 1-4; 131 complete and 133, verse 1. The scoring is for choir and strings, three trumpets, three trombones, two harps and a large percussion group. Bernstein used the Hebrew text, in which language they are sung on this disc. English and Hebrew texts accompany the record.

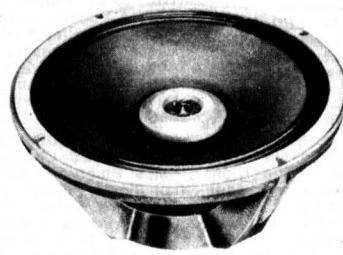
Bernstein's settings are popular, in the very best meaning of the term.

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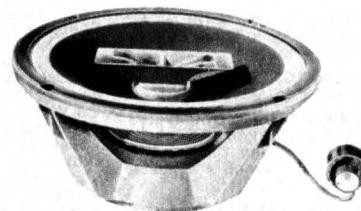
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Sometimes the music is a little reminiscent of that of other composers — Britten features most — but without aping any of them. Sometimes they are a little sentimental, though Bernstein never indulges in sentimentality. Indeed the whole adds up to some most enjoyable entertainment and is entirely free of a too pious overlay.

There is real jubilation in "Make a Joyful Noise unto the Lord," and a lovely pastoral air about "The Lord Is My Shepherd." The latter features effectively the passionless voice of a boy alto, John Bogart, in a mood of humility not usually associated with a more famous owner of that name. This is contrasted by some vigorous conflict in "Why Do the Nations Rage?", and "Lord, Lord, My Heart Is Not Haughty," sung with quiet eloquence, introduces a melody almost Verdian in its smoothness. The choir throughout is excellent and Bernstein handles the whole performance with great skill and reverence.

I am much less keen on the ballet "Facsimile" on the reverse side. This was commissioned by Jerome Robbins of the New York Theatre Ballet Company and had its premiere in that city as far back as 1946. The story of the ballet bears a close resemblance to that of Debussy's "Jeux" in which two men flirt with a girl; here you have two girls flirting with a man. It has an occasional brilliant passage but, for the most part, is a skilfully assembled pastiche. It is by no means representative of Bernstein the composer at his best, though it does offer Bernstein the conductor in fine form. This, too, is admirably performed and recorded.

★ ★ ★

SCHONBERG — Concerto for Piano and Orchestra, Op. 42. Glenn Gould (piano).
Concerto for Violin and Orchestra, 36. Israel Baker (violin).
The CBS Symphony Orchestra conducted by Robert Craft. CBS SBR235247.

Of these two works, the Piano Concerto is the little more accessible on first acquaintance. At any rate the comparative easiness of its first part — it is written in four continuous movements — might well please you enough to cope with the difficulties that arise later. If, however, you find these distracting, stop for a while and play the slow movement of the Violin Concerto which has, despite its screwed up tensions, many quite lyrical moments. But you will find both works well worth doing a little extra work on, if you feel you should know more of the work of the father of avant garde music, so little of which is readily available in recorded form.

But whatever you do, don't be put off by Milton Babbitt's analytical notes which belong to the parsing and analysis class and tell you very little about how the music sounds. I was frankly dismayed at having to work my way through the mass of corrosive verbiage which purports to instruct one in appreciation of the composer's music, as opposed to his method.

The soloists in both concertos are admirable, with Gould completely in command of his instrument and utterly faithful to the composer's intentions, and Baker making what must be one of the most difficult parts for solo violin

ever written sound, if not exactly like child's play, at any rate a lot easier than it really is. To these two accomplished musicians Robert Craft offers accompaniments that are always correct but, in contrast, a little pedantic. The sound is good average.

★ ★ ★

BEETHOVEN — Symphony No. 7 in A Major, Op. 92. Coriolan Overture, Op. 62. Boston Symphony Orchestra conducted by Erich Leinsdorf. RCA stereo. LSC2969.

With the fine Schmidt-Isserstedt/Vienna Philharmonic series of Beethoven symphonies in mind, I cannot recommend this one with any great enthusiasm. True, Leinsdorf makes an impressive start with a solemn but never pompous introduction, its climbing scale passages impressively muscled. And he keeps the dotted rhythm of the main body of the movement going with impressive accuracy. (This, by the way, is known as the "Amsterdam" rhythm because in order to keep the dotted notes cleanly in time the players often keep the word Amsterdam in their minds.) But after a while Leinsdorf's rigidity of beat tends to monotony.

I was disappointed, too, in the Allegretto, which is one of my favourite Beethoven movements. As you hear it here it is altogether too matter-of-fact. Things go better in the Scherzo, which Leinsdorf makes sound truly light-hearted and infectiously gay. Moreover, he is not of the school — as was Toscanini — which makes a vast difference in tempo between the Scherzo and Trio, changing the latter down, not even to second, but to low gear. Leinsdorf changes them just enough to make an effective contrast with what I think is a very happy result. The Finale is taken at a good brisk tempo, but there is never any suggestion of a bacchanale, which is what Beethoven was supposed to have had in mind.

The fill, the overture to Coriolan, is difficult to rob altogether of drama, but it should also convey the conflict of a strong character in a state of irresolution. This, alas, it seldom does in the performance you have here.

The sound throughout the disc is a little congested in the middle register.

★ ★ ★

BEETHOVEN — Triple Concerto for Violin (David Oistrakh), Cello (Sviatoslav Knushevitzky), and Piano (Lev Oborin), with the Philharmonia Orchestra conducted by Sir Malcolm Sargent.

Egmont and Coriolan Overtures. Berlin Philharmonic Orchestra conducted by Andre Vandernoot. HMV Concert Classic Stereo SOXL P30080.

I found Vandernoot's performance of Coriolan Overture on this disc anything but exciting. This, too, lacks the sense of inner struggle that is a feature of the Shakespeare play and Beethoven's music. But the main interest of this record is in Beethoven's Triple Concerto, which is not only seldom heard in the concert hall, but is also unknown to me on record, either. Triple Concerto means that there are three soloists, in this instance a piano, violin and cello, who must all be given their appropriate amount of activity. As a result you are often in the posi-

tion of having to listen to the theme stated in turn on each of the three instruments, and it is perhaps this which makes the Beethoven work sound more formal than his usual style.

Most nineteenth century composers ignored this kind of challenge, but not Beethoven. With him, if a problem existed, it was there to be solved. And this Beethoven did with about as much success as was possible in such a tricky medium. Some of his themes have a strangely eighteenth-century sound, while others, surprisingly, recall the line of early Verdi. Missing, however, is the usual conflict between themes that is so characteristic of most of Beethoven's work. But, to replace this, you will find an astonishing wealth of technical resources exploited in giving the soloists plenty to do that will keep an intelligent audience interested. Indeed, there is hardly a dull bar in the whole concerto.

The movement that appealed to me most was the very brief Adagio, no more than an interlude, which has the serene beauty of the slow movements of the middle-period string quartets. And the presentation of the solo parts by Oistrakh, Oborin and Knushevitzky are just about as faultless as you'd expect from such eminent musicians. Sargent, too, makes a valuable contribution, though there is not very much that he can work on to put up a spectacular show. In any case, do not regard this work as a mere curiosity. It is entitled to your interest on the sheer merits of the music and its performance.

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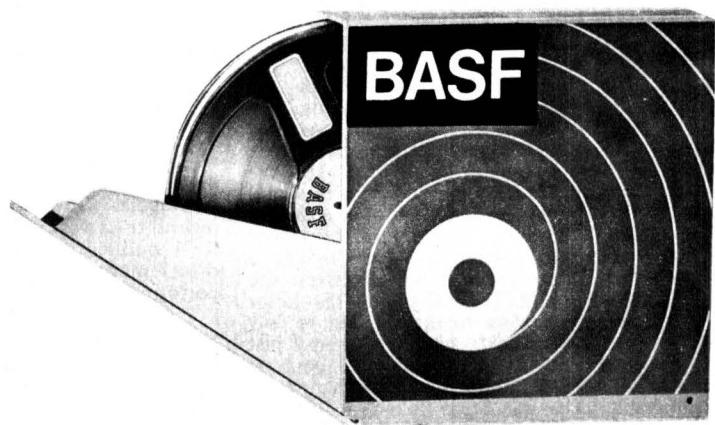
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DOCUMENTARY RECORDS

Reviewed by Glen Menzies

AROUND THE BOREE LOG, by John O'Brien. Read by Kevin Brennan. Calendar (Festival) Mono R66-250.

As the cover of this album does not supply any details about the author, and simply lists the titles of the 16 poems on the disc, many readers will be in the dark about just who John O'Brien is. The poems reveal that Mr O'Brien is obviously a devout Catholic brought up in the "bush"—in fact the name is only a nom de plume for Monseigneur Hartigan, a catholic priest from outback N.S.W.—and he leaves us in no doubt about how much he regrets the passing of the era of gigs, traps and ponies: the tone of much of the verse is that of a long, regretful glance over the shoulder at what he regarded as better times:

"Where the trees seemed always greener and the life was always cleaner."

"Simple lives and simple pleasures never stinted in the measure."

"There was something good at Caseys,
Something clean and good at Caseys,
Spending Sunday down at Caseys
after Mass."

and it comes as no surprise to come across lines about "little Irish Mothers."

All this is harmless enough, I suppose, but where the poems deal with war themes, the author's somewhat chauvinistic attitude is quite explicit. As the 16 poems play through, one becomes uncomfortably aware of a growing sense of tedium, the subject matter is too limited, the versifying lacks the skill that is apparent in the work of more gifted poets and the rhyming scheme is too predictable.

The reader, Kevin Brennan, presumably made this album before journeying to London to find "fame and fortune." His reading here is of the "stage-Irish" kind, played up for all its worth and materially adding its quota of monotony.

For once I must cry out against an overgenerous supply of a poet's work, and this is only a selection from "Around the Boree Log."

★ ★ ★

JULIUS CAESAR JONES. By Malcolm Williamson. Libretto by Geoffrey Dunn. With April Cannello, Norma Proctor, Michael Maurel and Company, and The Finchley Children's Music Group, directed by John Andrewes. Recorded in association with the British Council. Argo Stereo ZRG529.

A record of a full-scale opera for children may seem to be an odd choice for this column, but it follows our practice of drawing attention from time to time to worthwhile releases of this kind. For musically minded children and their parents this one is of more than passing interest. It surprises

me that no one has taken up this opera here.

The story is concerned with the emotional progression of childhood and the failure in understanding between adults and children — a breakdown in communication in fact. In a most informative sleeve note about the writing of the opera Malcolm Williamson says: "It was this lack of communication that interested Geoffrey Dunn and me, giving a starting point to the story of Julius Caesar Jones. For operatic purposes time is telescoped, and within the fortnight through which the action is spread we see the children shed their childish fantasies and grow into a more worldly atmosphere, crossing the Rubicon of puberty, as their seniors slide slowly towards middle-age, second childhood and old age. Every attempt to reach a common viewpoint is frustrated by in changing and different perspectives."

The game of fantasy which the children enact in the garden of the Everett's home is more "real" to them than the mundane world of their parents. The fact that it almost ends in tragedy gives the work plenty of inner tension with the steady progress toward a powerful climax.

Malcolm Williamson's music has a modern sound but manages to be conventionally approachable at the same time. Mr Williamson is a very successful young Australian composer now living in England who is probably best known here for his colourful and appropriate score for the Helpmann ballet, "The Display."

Both dramatically and musically this is a well conceived work and the performance does full justice to the simple directness of the score. The singing of the soloists and chorus is first class with fine instrumental playing from the Finchley Children's Music Group. A libretto is supplied but the diction of the singers is so good that it is hardly necessary. The stereophonic spread is outstanding and the sound effects are at times quite startling.

★ ★ ★

PATHWAY TO YOUR MIND: Preparing the mind and body for meditation. Decca Mono LKA-7625.

Originally released on the English Major Minor label, this LP was, I would imagine, originally aimed at Yoga pupils, that is if the name Sivananda School of Yoga on the label is anything to go by. I know nothing about this school and the cover note fails to throw any light upon it. The cover note does however, offer this intriguing advice, quote:—

"Settle the body comfortably on a rug or folded blanket flat on the floor. Make sure that your clothing is not tight so as to restrict your breathing or circulation. Put aside all thoughts of the outside world. Direct yourself inwards as if you were entering a new world away from our crowded noisy

existence. A world free from anxiety, worry and care, where calm and peace prevail. Let your body and mind become receptive to the suggestions which follow in the record."

Side 1 opens with the sound of waves breaking on the shore and a few bars of what sounds vaguely like Sibelius' "Swan of Tuonela." With no clue given about the instructors one naturally expects a "Peter Sellars type" Indian accent to emerge from the speakers; instead it is a pleasant surprise to hear a good English voice reading with a professional actor's

(Continued on page 158)

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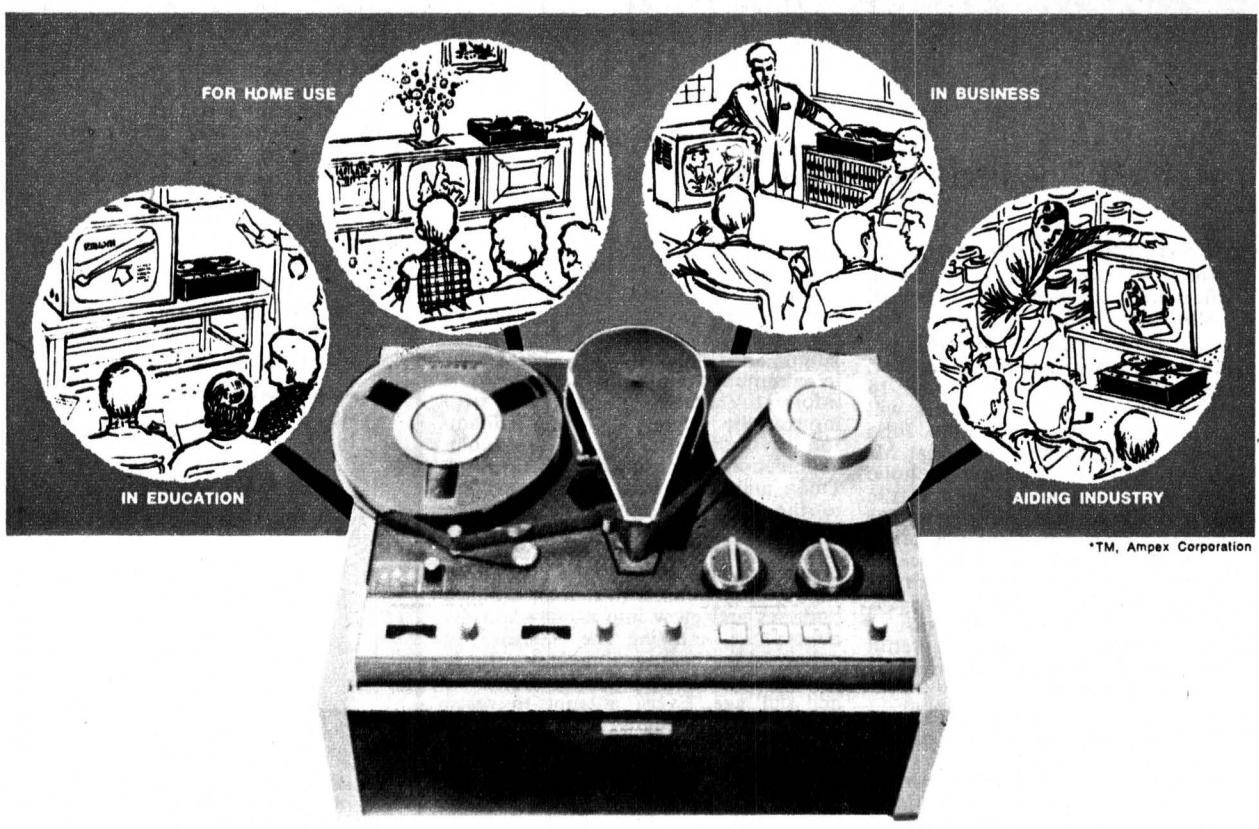
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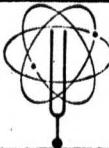
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VARIETY FARE

Reviews by: Neville Williams Harry Tyrer
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BE STILL MY SOUL. George Beverly Shea, with orchestra and choir conducted by Ralph Carmichael. Stereo, RCA Dynagroove LSP-3945. Also in mono LSP-3945. Interest: More Bev. Shea numbers. Performance: Sincere. Quality: Excellent. Stereo: Orchestra well spread.

Not surprisingly, perhaps, Ralph Carmichael's contribution to this new album is a colourful instrumental backing, spread wide by the stereo channels. Against this richly textured background, Bev. Shea sings in his characteristic style, not above criticism for his intonation, but with the deep sincerity which has made him perhaps the best loved Gospel singer of all time.

The theme is his trust in his God: All My Life—No, Not One—Be Thou My Vision—O' My Lovin' Brother—Until The Hills—Safe In The Arms of Jesus—Singing I Go—Be Still My Soul—Keep Your Voices Singing—Guide Me, O Thou Great Jehovah—In The Sweet By and By—The Saviour Is Waiting.

Another one for Bev. Shea fans. (W.N.W.)

★ ★ ★

THE CRUSADER MEN, directed by Cliff Barrows. Stereo, Word (Gospel Film Ministry) WST-8366-LP. Interest: Male voice choir. Performance: Superb. Quality: Excellent. Stereo: Effective.

The Crusader Men are individual singers drawn from all walks of life, who come together as a group to provide the choral items used in the Billy

Graham "Hour Of Decision" radio broadcasts. Meeting in the RCA studios in Chicago, they team up with instrumentalists Tedd Smith and Don Hustad, under Cliff Barrows as conductor.

Such a group should be good and they are — very good! Harmony, balance, phrasing, diction are all of a high order, as also the quality of the recording in the technical sense.

As is usual with Billy Graham choir music, the hymns are well known but carefully selected with an eye to merit both in word content and music: Hallelujah, We Shall Rise — Who Is On The Lord's Side? — O For A Thousand Tongues To Sing — And Can It Be — Tis Marvellous and Wonderful — All Glory, Laud and Honour — Christ The Lord Is Risen Today — Amazing Grace — I'll Be A Friend Of Jesus — He Wore A Crown Of Thorns — The Unveiled Christ — Bringing In The Sheaves.

Recommended. (W.N.W.)

★ ★ ★

I'LL WALK WITH GOD. Slim Whitman. Mono, Imperial (Festival) IRL-32,663.

Interest: Gospel, western touch. Performance: Grows on one. Quality: Good.

"I'll Walk With God" is a song which, to me, is one for a big male voice and Slim Whitman's light tenor seems anything but appropriate; nor is the impact improved by his reference to an "elping hand" and an "umble plea." But you have to hand it to him when he takes an effortless top B-flat!

The remaining numbers are far better choices for his particular style: Whispering Hope—I'm A Pilgrim—An Evening Prayer—Jesus Took My Burden—Sunrise—Walk Beside Me—

Instrumental, Vocal & Humour

THE WORLD OF LIGHT MUSIC. The Pro Arte Orchestra conducted by Gilbert Vintner. Encore (E.M.I.). Stereo SOELP 9371.

Interest: Light music. Performance: High standard. Quality: Very good. Stereo: Normal.

This is a particularly good bargain for budget priced record buyers. Although released on the Encore label it appears to be the first release for this disc; yet despite this, it contains a first-rate performance of some excellent music, and the sound quality cannot be faulted. Gilbert Vintner has apparently stepped into the shoes of George Wel-

don, whose sad death a few years ago left a big gap in the ranks of conductors specialising in light music. The Pro Arte Orchestra is a very accomplished group and play very well under Vintner's baton.

The numbers presented here have been chosen to represent as many countries as possible. Thus we start with "The Merrymaker's Dance" by English composer Eric Coates, then go on a world tour with: Herdmorden's Dance (Sweden) — Praeludium by Jaernefelt (Finland) — Entrance of the Little Fauns (France) — Under the Linden Tree (Austria) — In a Harbour Town (Germany) — Dance of the

Each Step I Take—The Great Judgment Morning—He Lives On High—Today Is Mine—When I Go To The Garden.

With organ, rhythm bass, guitar and vocal backing, it adds up to some quite pleasant listening, country and western style. (W.N.W.)

★ ★ ★

SUNSHINE IN MY SOUL. Songs of Joy. Burl Ives with Choir and Orchestra conducted by Owen Bradley. Mono, Calendar (Festival) R66-475.

Interest: Old-time Gospel favourites.

Performance: Unaffected.

Quality: Normal.

The whole atmosphere of this album is essentially that of an old-fashioned Gospel sing-a-long, with its changes of mood, its spontaneity and the odd syllable that falls a casualty to hasty tempo. Filling out the pattern, Burl Ives is well cast in the role of song leader.

I'll be surprised if you don't know all the hymns: Sunshine In My Soul —Where He Leads Me—Will There Be Any Stars?—Blessed Assurance—We're Marching To Zion—Standing On The Promises—Beulah Land—When They Ring Those Golden Bells—Leaning On The Everlasting Arms—Let The Lower Lights Be Burning—Bring Them In—Fairest Lord Jesus.

If you like these old hymns, sung simply and happily, you'll enjoy this Burl Ives Gospel sing-a-long. (W.N.W.)

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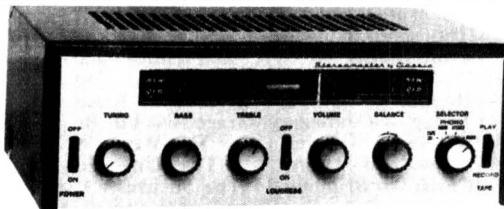
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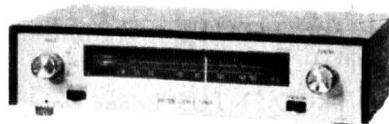
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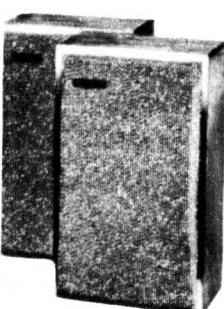
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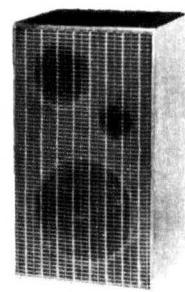
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* * *

SPUTNIKS FOR ORCHESTRA.

Stanley Black conducting the Royal Philharmonic Orchestra. Decca Phase Four (E.M.I.), Stereo only SKLA 4899.

Interest: Russian masterpieces.
Performance: First rate.
Quality: The best.
Stereo: Excellent.

Stanley Black started out in music as a jazz pianist, but has now "graduated" to the classical field, where he has established a growing reputation as a conductor of light classics. This selection is possibly his most ambitious yet at conducting, as it is approaching the realms of the pure classics. The program comprises works of the great Russian composers: Night On The Bare Mountain (Moussorgsky) — In The Steppes Of Central Asia (Borodin) — Flight Of The Bumble Bee (Rimsky-Korsakoff) — Marche Slav (Tchaikovsky) — Nocturne (Borodin) — Comedian's Galop (Kabalevsky). Black gives an entirely satisfactory account of these works; in fact I should go so far as to say that I enjoyed them as much as any performance I have previously heard. The Royal Philharmonic is a wonderful orchestra, and play very well under Black's baton.

I do not doubt that much of the aforementioned pleasure can be attributed to the Decca Phase Four Sound, which in my book is the best available in the world today. If you want to demonstrate your equipment at its best, this is the type of record for the job. (H.A.T.)

* * *

NUTCRACKER AND SLEEPING BEAUTY SUITES. (Tchaikovsky).

The Royal Philharmonic Orchestra conducted by Sir Adrian Boult. Studio 2 Stereo (E.M.I.) SCXO 7827.

Interest: Popular Tchaikovsky.
Performance: Superb.
Quality: Excellent.
Stereo: Excellent.

One tends to become blasé about these often recorded popular suites, but I really enjoyed this performance by the Royal Philharmonic with that fine musician Sir Adrian Boult conducting. The lively and precise playing of the orchestra is in sharp contrast to some of the bored sounding performances to often committed to disc in works of this type. If you do not yet have a good stereo performance of these suites in your collection, this version should certainly be on your short list of possibles.

Side one contains all eight pieces of the suite arranged by Tchaikovsky, but has a generous bonus in the shape of the wonderful Pas de Deux. I could never understand why this piece was not included in the original suite, as I find it the most enjoyable piece of the whole ballet. Tchaikovsky did not arrange a suite of the Sleeping Beauty

music, and the selection here begins with the Introduction and Grand March, then follows the famous Waltz from Act 1. The remaining pieces are grouped together in one track comprising: Pas de Caractere (Puss in Boots and the White Cat—Polacca—Pas de Deux (Aurora Variation from Act 3)—Pas d'Action (Aurora's Variation from Act 1)—Pas d'Action (Rose Adagio from Act 1). The Studio 2 Stereo sound is first rate. (H.A.T.)

* * *

SOUND IN THE EIGHTH DIMENSION.

Command (Festival) Stereo SNDL-932,871. Available in mono.

Interest: New stereo technique.
Performance: Good standard.
Quality: The best.
Stereo: Likewise.

The Command company has always been noted for the high quality sound of its discs, and now they are using a new system which they call "Sound in the Eighth Dimension." This disc has been specially made to demonstrate the capabilities of the system and it goes without saying that the sound is as good as it can be. The major portion of the space on the back of the sleeve is given over to a publicity spiel on the new system and, stripped of the eulogistic sales talk, the new system appears to be a multi-channel recording technique with extreme care being taken to ensure that stereo spread is smooth and as wide as possible. The results are certainly impressive from the sound point of view.

The orchestra is one of those very fine combinations which American recording companies seem to be able to call upon at will, playing here under the direction of Robert Byrne. The selection comprises: Limehouse Blues — Ebb Tide — Talk to the Animals — This Heart (Paris) — Spanish Eyes — March of the Space Cadets — South Rampart Street Parade — The Sound of Music — El Gato Montes — Blue Hawaii — Get Me to the Church on Time. Not a very enterprising selection but presumably the main aim was to demonstrate the sound quality. To show off the stereo capabilities of the system, crowd sound effects are included in some tracks. (H.A.T.)

ENCORE. Henry Mancini and his Orchestra. RCA Dynagroove Stereo LSP3887. Available in Mono.

Interest: Current hits.
Performance: Smooth and lush.
Quality: Excellent.
Stereo: Normal.

Henry Mancini's style of music is based on technical excellence in all departments. He is an expert arranger, composer, conductor and performer (though he chooses to appear only seldom in the last-named role). Here, he uses his multiple talents to good effect. Side one begins with a selection called "Portrait of the Beatles" and comprises Mancini's arrangements of the following: A Hard Day's Night — And I Love Her — All My Loving — Norwegian Wood — Michelle — Yesterday. This is followed by "Foreign Film Festival" which includes: Born Free — Where Is Your Heart — More — Samba de Orfeu — Zorba The Greek Theme — I Will Wait For You.

Side 2 has "Music From Hollywood," comprising: Exodus — Theme from "Man With The Golden Arm" — Hi-Lili, Hi-Lo — Somewhere My Love — Conquest — Laura. Finally there is a section entitled "Three by Mancini" with Days Of Wine And Roses — Charade — Moon River. The lush arrangements and fine performance under Mancini's baton make this fine listening. The Dynagroove sound is as good as ever, being clean and bright with no noticeable distortion, and well spaced stereo. (H.A.T.)

* * *

GREATEST HITS, Volume III.

The Philadelphia Orchestra conducted by Eugene Ormandy. CBS (Australian Record Company) Stereo SBR235260.

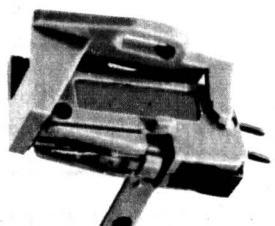
Interest: Light classics.
Performance: First rate.
Quality: Excellent.
Stereo: Good spread.

This is the third in the series of discs put out by CBS under the "Greatest Hits" title with the Philadelphia Orchestra under Ormandy. I think the title is inappropriate, since the Philadelphia Orchestra is obviously capable of presenting much greater music than the light fare offered here.

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The program is, in fact, almost exclusively from the light classical repertoire: Comedian's Galop from "The Comedians" (Kabalevsky) — Anitra's Dance from "Peer Gynt" (Grieg) — Farandole from "L'Arlesienne" (Bizet) — Nocturne for String Orchestra (Borodin) — Galop from "Dance of the Hours" (Ponchielli) — Fire Bell Polka (Josef Strauss) — Londonderry Air — Camptown Races (Foster) — Air from Suite No. 3 (Bach) — Grand March from "Aida" (Verdi).

If, like me, you like your light classics played by a full orchestra rather than the numerous "light orchestras" which churn out this kind of material, you will appreciate the splendid playing of the Philadelphia Orchestra in this pleasing collection. The only thing I have to quarrel with is the inclusion of only a short section of the "Dance of the Hours" and the section which I personally find the least appealing, at that. The sound is of excellent standard, with good stereo spread. (H.A.T.)

★ ★ ★

SCHUBERT: PIANO MUSIC. Alfred Brendel piano, Vanguard (Astor) Stereo VSD 71157.

Interest: Piano classics.

Performance: Sensitive and lyrical.
Quality: Good sound, some surface noise.

Stereo: Not significant.

Alfred Brendel is one of the foremost interpreters of Viennese classical music today and his performance of the great Schubert Sonatas in C Minor and C Major presented here is full of the most wonderful delicacy and lyricism yet with the elements of fire demanded by this composer's works for piano. Although not an outstanding pianist himself, Schubert wrote works for the piano which demand great technical skill. Despite this, Brendel never sounds over-extended in the difficult passages with which these works abound. The C Major work was never finished by Schubert, and consists of only two movements. As a fill for side 2, Brendel plays the 16 German Dances, Opus 35. This is an unfortunate choice, since, although they are very pleasant trifles, they sound almost trite after the drama and beauty of the sonata movements. I think one of the other short sonatas would have been a better fill.

While not quite in the same class technically as the best discs coming from the leading companies nowadays, the sound quality of this disc is of acceptable standard. There was slight surface noise in the review copy. (H.A.T.)

★ ★ ★

FOLIO OF GREAT SONGS — Acker Bilk (with the Leon Young String Chorale), Columbia (EMI) Stereo SCX07844.

Interest: Pleasant mood music.
Performance: Easy listening.
Quality: Good recording.
Stereo: Well balanced.

Since the world-wide success of "Stranger On The Shore" in 1961 (four million copies sold to date), Acker Bilk has been following a two-fold career with his Paramount Jazz Band on the one hand and the 15 or so mood albums which he has recorded with the Leon Young String Chorale on the

NEW READER'S DIGEST ALBUM

HEAR THEM AGAIN. Reader's Digest 10-Record set in box, complete with 32-page fully illustrated 12 x 12-inch brochure. Stereo or mono.

Perhaps it was because of a technical background, but my immediate reaction to this set was to marvel at the amount of work that must have gone into its preparation. Here, in the same set, are recordings made all through the years from 1916 to the present day—and yet the modern doesn't laugh at the old.

The 1916 track, by the way, is "O Sole Mio" by Enrico Caruso. It has been amazingly restored and is far and away the best recording I have ever heard of the voice which gave such tremendous impetus to the recording art. The same kind of job has been done on a 1921 recording of Fanny Brice's "My Man" and several others from the 1927-8 era.

According to a brief—and modest—note, restoration of these old recordings involved, first, the production of the best possible pressing from the original metal. The groove shape was then closely studied to secure an accurate stylus fit. This care has resulted in the almost complete elimination of distortion due to mistracking.

The sound was then transferred to tape and, by patient editing, the inevitable clicks were erased, one at a time. Then followed frequency separation to secure a simulated stereo effect, frequency compensation, and the addition of enough synthetic echo to give some life to the old dead-studio recordings. The resulting tracks blend amazingly well with others made at a

later period and from modern multi-track tapes.

The accompanying brochure gives detailed background on each track and on the artists involved. I didn't count them, but the literature refers to "122 Great Songs, 95 Great Singers." The literature, which many will have received through the post, also lists the songs and the singers in much greater detail than I can hope to do here. Briefly, however, the contents might be summarised as follows:

Record 1—beautiful, tuneful music; record 2—operatic stars in lighter moments; record 3—big bands and their vocalists plus, on side 2, the unforgettable blues; record 4—singers and the rhythm era; record 5—the movie singers; record 6—the big-name pop singers; record 7—great moments from the Broadway musicals; record 8—country and western at its best and, on side 2, the golden voices of radio; record 9—the immortals and, on side 2, the big-name vocal entertainers; record 10—all-time hit parade, a collection of favourite tunes and favourite artists from the more recent years.

There's a lot of listening in this new set, a lot of scope for nostalgia and a lot of interest from the collector's viewpoint. And, as I said earlier, a lot of work for those who had to face up to its technical problems!

Interesting, enjoyable and listenable. (W.N.W.)

other. (His jazz playing has, I think, suffered somewhat in the process but that, as they say, is another story.)

Bilk's warm, reedy clarinet is splendidly suited for this kind of album—restful, undemanding and very pleasant. He plays mainly in the lower register and his technique is more than adequate for the simple, melodic lines beyond which he rarely ventures.

The 12 songs are well chosen. Standards like "Georgia On My Mind," "The Very Thought Of You" and "Dinah" blend together very well with more recent songs of quality like "Yesterday," "Moon River" and "I Left My Heart In San Francisco."

Nothing very inspiring happens on the 35 minutes of this album, but for lazy late-night listening it could hardly be improved. (T.F.C.)

★ ★ ★

AIRS ET MELODIES CLASSIQUE.

Tino Rossi, tenor, with orchestra. Encore (E.M.I.) stereo SOEX 9395.

Interest: Popular classical songs. Performers: Warmly sympathetic. Quality: Poor.

Stereo: Barely there.

Despite the handicap of having had very little formal musical training, Tino Rossi is pleasant to listen to, because of his natural singing talent, and warm unaffected delivery. I was immediately attracted to this disc by the selection of tunes, which includes many old favourites, all wonderful tunes. However, I was sadly disappointed by the very poor sound

quality. There is noticeable distortion in every track, with severe background noise. I can only assume that these tracks have been taken from old 78 r.p.m. recordings, and not too skilfully adapted.

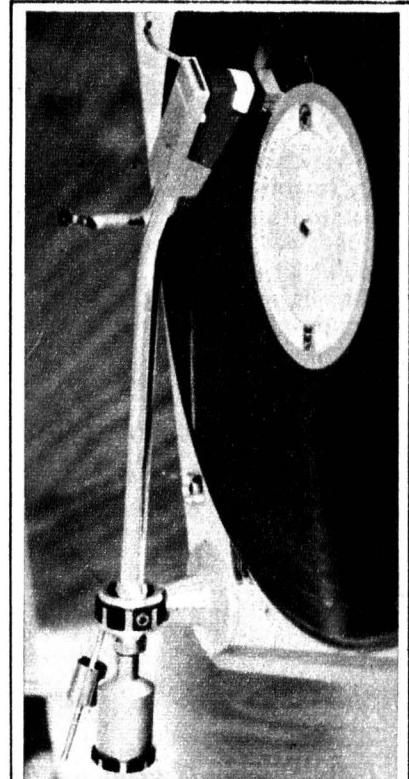
The contents are: Ave Maria (Gounod)—Ideal (Tosti)—Berceuse de Jocelyn (Godard)—Pensee D'Automne (Massenet)—Tristesse (after Chopin)—Ave Maria (Schubert)—Romance de Maître Pathelin (Bazin)—Si Vous L'avez Compris (Denza)—Le Roi d'Ys (Lalo)—Si Tu le Voulais (Tosti)—Ou Voulez-Vous Aller (Gounod)—Le Reve Des Grieux (Massenet). Despite the attractive contents and the virtues of the singer, I cannot recommend this to anybody whose equipment has any pretensions to high fidelity. (H.A.T.)

★ ★ ★

LATIN VILLAGE. Martin Denny and his orchestra. Liberty (Festival) Stereo SLYL-932,658. Available in mono.

Interest: Latin American tunes. Performance: Excellent. Quality: The best. Stereo: Well spread.

This latest Martin Denny release is obviously intended as a companion disc to the excellent "Spanish Village" reviewed here some months ago, and has all the features which made the earlier disc such enjoyable listening—smoothly swung performances of some of today's best tunes, skilfully arranged and presented in top quality sound. Martin Denny has a particular way of



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The arm was reviewed in "Electronics Australia". Here are some excerpts . . . "Although of impressive appearance and an excellent performer, the tone arm sells at quite a modest price"—"Specifications for the arm show that it is designed to track at stylus pressures as low as half a gram, so we adjusted the stylus pressure accordingly. We found that the arm will indeed track under these conditions, without groove jumping or skating, even with loud passages towards the centre of the disc, where conditions are most severe". Write for your copy of this report.

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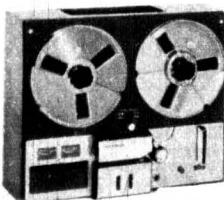
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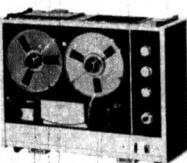
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arranging which is distinctive and very listenable. If you want to sample, listen to his treatment of "Manha de Carnaval" which begins the second side. The other titles are: Angelito—On Green Dolphin Street—Corcovado—Without You—Ho-Ba-La-La—Something Latin—Latin Village—The Girl From Ipanema—Malaguena—Sugar Cane—Flying Down To Rio. This is music which should appeal to most tastes. (H.A.T.)

★ ★ ★
**DOLLY CATCHER — The John
Schroeder Orchestra. Astor Stereo
SPLP1232.**

Interest: Strictly for the birds.
Performance: Unbelievably poor.
Quality: Well recorded but excessive surface noise.

Stereo: Makes little difference.

According to the sleeve-note, this record is designed exclusively for dolly catchers. Thus we have dolly-catching tunes; a dolly-catching producer; arrangements designed to assist the dolly catcher; even dolly-catching musicians and engineers!

In short, we have an absolutely ludicrous album of which English Pye ought to be ashamed.

The material is fifth-rate and the arrangements completely lacking in style and appeal. The only moments which really caught my interest were the trombone and tenor solos on "Up, Up And Away."

The album could just about scrape by for a very dull party on the strength of the Beatles' "Lucy In The Sky," Stevie Wonder's hit "I Was Made To Love Her" and Johnny Pearson's "To Wendy With Love."

If anyone really cares, it runs for a mercifully short 31 minutes. (T.F.C.)

★ ★ ★
**IT MUST BE HIM. Al Caiola, guitar,
with orchestra. United Artists,
Stereo SUAL-932,830. Available
in mono.**

Interest: Popular guitarist.

Performance: Relaxed.

Quality: Excellent.

Stereo: Normal.

The relaxed style of guitar-playing favoured by Al Caiola has wide appeal and, if he is your cup of tea, this disc can be recommended. The tunes are all very popular and are well played with some excellent instrumental support. The tunes are: It Must Be Him—Tara's Theme—Here Is Where I Belong—if He Walked Into My Life (from "Mame")—The Sound of Music—High Chaparral—Live for Life—The Impossible Dream—Cabaret—Theme from "November"—Lara's Theme. Incidentally, this is the twenty-eighth recording of Al Caiola released by United Artists, which speaks volumes for his popularity. (H.A.T.)

★ ★ ★
**ROBERTO MANN'S ACCORDION
SOUNDS. Roberto Mann, accord-
ion, with orchestra. Deram
(E.M.I.) stereo SMLA 1016.**

Interest: Accordion virtuoso.

Performance: Very pleasing.

Quality: Excellent.

Stereo: Excellent.

If you find pleasure in the "continental" sound of the accordion, you should make a point of listening to this one, as it has a great deal to offer: a very pleasing performance by the solo artist, who plays with great skill and sensitivity; a fine selection of tunes; a very generous program of

16 tracks; high quality sound recorded in the Deram system, with well spread stereo; good support from the accomplished supporting orchestra; skilful arrangements. This should be enough to let the reader know that I found this disc very good listening, and it only remains to list the titles: Java — Rattlesnake — The Lonely Ballerina — A Walk in the Black Forest — Il Silenzio — Pepe — Beware, Beware — The Jarvie Was A Leprechaun — I Was Kaiser Bill's Batman — On a Carousel — Autumn Leaves — Edelweiss — Monte Carlo Tango — Skye Boat Song — Sexton Blake Theme — Castelfidardo. Highly recommended. (H.A.T.)

★ ★ ★

TRAVELLIN' MANDOLIN. Dave Apollon and the Journeymen. Calendar (Festival) stereo SR66-9,484. Available in mono. Interest: Virtuoso mandolin. Performance: Sparkling. Quality: Excellent. Stereo: Good even spread.

Here is a disc which I can recommend to people with well developed musical tastes who appreciate good tunes and expert performance. To enumerate the particular virtues: (1) Mainly familiar light classical tunes which most people know and enjoy; (2) Brilliant performance on the mandolin by Dave Apollon; (3) Excellent support from his band, playing expert arrangements; (4) Technical excellence with bright, clean sound and good stereo channelling. With all this, it is a very pleasant surprise to find the recording put out on the low price Calendar label.

The track titles are: Moscow Nights — Just Say I Love Her — Paganini Stomp — Valse Triste — Londonderry Air — Streets Of Athens — Malaguena — Scheherazade — Schon Rosmarin — Meadowland — Zigeunerweisen — An Evening In Budapest. For a display of sheer virtuosity, listen to "Paganini Stomp." This is rousing good fun, which those who are classically orientated will appreciate. On the other hand, if you like traditional airs, listen to the floating melody of "Londonderry Air" in this arrangement. Recommended. (H.A.T.)

★ ★ ★

AT THE MOVIES—The Ray Charles Singers. Command (Festival) Stereo SNDL932711 (also in mono).

A SPECIAL SOMETHING—The Ray Charles Singers. Command (Festival) Stereo SNDL932443 (also in mono).

Interest: Popular vocal group. Performance: Professional but rather dull. Quality: Beautifully recorded.

Stereo: Good separation.

Both these albums are fairly typical outings for the Ray Charles Singers. Sixteen voices in all, they are extremely professional and accomplished and Mr Charles himself (not, of course, to be confused with the great blues singer and pianist) has the reputation for setting extremely high musical standards in his work.

The music in these two albums is pleasant enough in small doses but over two sides of an L.P., the lack of variety and feeling in the singing becomes a little tiresome. A soap powder jingle one day, a new album the next . . . it probably makes little difference

to the emotional involvement of the Ray Charles Singers.

The very straight and rather dull vocal and musical arrangements make first-rate material an absolute necessity. On neither of the albums under review is this really true. The "Movies" L.P. has "Gentle Rain," "All" and "This Is My Song," while "A Special Something" contains "Sunrise, Sunset," "California Dreamin'" and "Alfie." But both albums also include some very second-rate songs.

Even the most devoted admirer of the Ray Charles Singers would probably wish to purchase only one of these and "At the Movies" is, on balance, slightly the better of the two. At 34 minutes, it also plays for some 2 minutes longer. (T.F.C.)

★ ★ ★

EASY TO REMEMBER. Bing Crosby. Calendar Hits (Festival) mono only R66-473.

Interest: Early Bing Crosby. Performance: As ever was. Quality: 1930-ish.

There must be literally dozens of "Bing" recordings still in the catalogues, including several of the "Best of Bing" type — a two-disc set on these lines was reviewed in these columns some months ago. I suggest that only the most avid Bing Crosby fan will want the present offering. The tunes are from films of the 1930s: "Here Is My Heart" — "Mississippi" — "Two For Tonight" — "The Big Broadcast of 1936." Some may regard this as vintage Crosby, but the majority of the songs have long since sunk into a well-deserved oblivion. The titles: Love Is Just Around The Corner — June In January — With Every Breath I Take — It's Easy To Remember — Swanee River — Down By The River — Without A Word Of Warning — Two For Tonight — From The Top Of Your Head — I Wish I Were Aladdin — Takes Two To Make A Bargain — I Wished On The Moon.

I gather these tracks are all from the original soundtracks, as despite their advanced age, there is none of the surface noise invariably present in remakes from 78rpm discs. However, the sound quality is very far from high fidelity as we understand it today. (H.A.T.)

★ ★ ★

FATHER KEVIN O'CONNOR, the singing priest of the outback, with the Bob Young Orchestra. Calendar (Festival), mono only R66-455.

Interest: Traditional songs. Performance: Pleasing. Quality: Good.

This recording was originally released on the Festival label in 1966. Though a popular and accomplished singer, well known from his frequent radio appearances, Father O'Connor has not the star quality which goes with big sales, and it was possibly a little optimistic of Festival to put this recording out on their full price label. Now that it has been reissued on the low priced Calendar label it becomes a more attractive proposition for those with a liking for the type of traditional ballad and folk song which comprises Father O'Connor's repertoire.

This selection contains: The Little Irish Girl — Joe the Carrier Lad — Calling To Me — You'd Better Ask Me —

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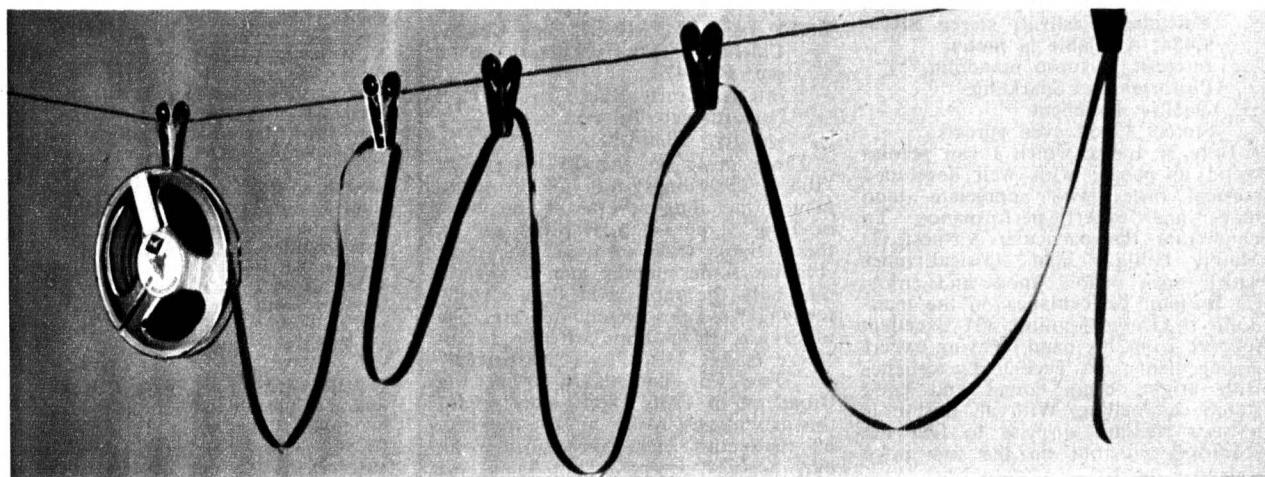
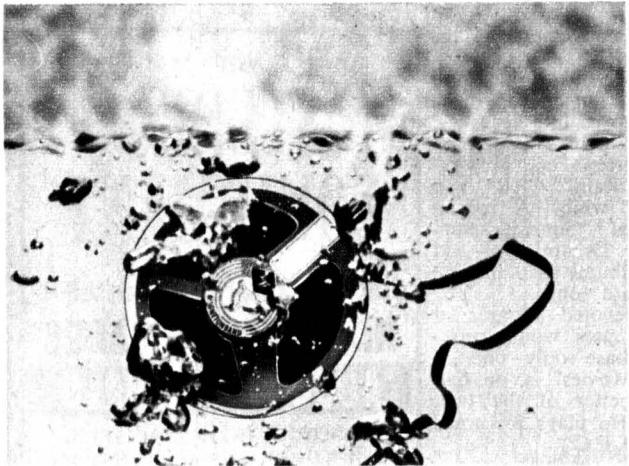
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★ ★ ★

THAT'S HOW A HEARTACHE BEGINS. Patsy Cline, with various choral and instrumental groups. Calendar (Festival) mono R66-431.

Interest: Country and Western.

Performance: Outstanding.

Quality: Good.

For country and western fans, this disc represents the bargain of the year. The sad death of Patsy Cline in an airline disaster a few years ago deprived the country and western scene of one of its brightest stars, and for many people, Patsy Cline was the C. and W. queen. Here she sings many of the songs which made her famous. The titles are: Love Letters In The Sand—Bill Bailey, Won't You Please Come Home—Shoes—Lovesick Blues—Lovin' In Vain—I'm Moving Along—That's How a Heartache Begins—He Called Me Baby—There He Goes—Crazy Dreams—I'm Blue Again—Love, Love, Love Me, Honey Do. The supporting group varies from track to track, but is good in every case. The disc is available in mono only, but sound quality is of good standard. If you are a country and western fan, don't miss this one. (H.A.T.)

★ ★ ★

ROLF HARRIS. B.B.C. Television's "The Rolf Harris Show." Mono. Columbia OSX-6216.

Interest: The B.B.C. Rolf Harris.

Performance: Full of zip.

Quality: Good.

The success of Rolf Harris on B.B.C. television is a matter of history, while the same shows appeared to enjoy comparable popularity here. They

depended for their success, not only on the carefully rehearsed "spontaneity" of Rolf Harris himself—and that of the associated youthful cast—but on a very thoroughly rehearsed orchestra and chorus, with arrangements to match.

The songs on this album have been hand-picked from the series and reflect a wide variety of style and locale—a variety which will mean most to those who saw the television series or who are Rolf Harris fans, anyway. Included in the 15 titles are: Valse Mathilde—I've Never Seen Anything Like It—Jake The Peg—Thoroughly Modern Millie.

A reminder of a lot of TV screen fun. (W.N.W.).

★ ★ ★

BILL COSBY. To Russell My Brother. Stereo, Warner Bros. WS-1734.

Interest: Humorist-entertainer.

Performance: Obviously went over.

Quality: Excellent.

Stereo: Not important.

An entertainer must needs "have something" to command an audience of over 10,000 at the Cleveland Public Auditorium, to entertain them for 2½ hours and to keep them applauding warmly and spontaneously throughout the whole show.

The main feature of the show, in January last—and of this album—is a half-hour monologue in which Bill Cosby recalls his own unglamorous childhood and re-enacts the incidents of a typical night: Two small boys sharing the one too-small bed—bickering as small boys do, fighting over the bedclothes and finally inviting the attentions of a wrathful father. The story is of two Cosby brothers but, in reality, the audience is reacting to their own childhood antics, skilfully calmed by this gifted entertainer.

Personally, I would have a preference for some of the shorter, more deliberately funny monologues in earlier Cosby albums but this one will nevertheless be appreciated by confirmed Cosby fans. (W.N.W.).

abilities as a band-leader, much of the Clouds' success must be attributed to the arranging skills of Mary Lou Williams, who worked for Kirk as arranger and pianist until 1942. Mary Lou wrote six and arranged all but three of the tracks on this album. She also solos consistently well on most of them with her Hines-influenced but very individual piano.

Kirk's main soloist was the magnificent and forgotten tenorist, Dick Wilson, an incredibly fluent and imaginative musician. Wilson's superb tenor can be heard on ten tracks and he is particularly devastating on "Lotta Sax Appeal" and "In The Groove."

The overall quality of the first nine tracks (1936-1938) is excellent but the remaining five tracks are somewhat inferior and not altogether typical of Kirk's music.

Nevertheless, in all the circumstances, this is a valuable and recommended reissue set. Frank Driggs' sleeve note provides a scholarly history of the band and the album plays for 43 minutes. (T.F.C.)

Popular Jazz

INSTRUMENTALLY SPEAKING —

Andy Kirk and his Clouds of Joy. Festival — Jazz Heritage Series DL-32757.

Interest: Superb K.C. Big Band (1936-42).

Performance: Valuable reissue (especially first nine tracks).

Quality: Adequate remastering.

Andy Kirk's Clouds of Joy have been one of the most under-rated and under-recorded bands in jazz. In all, Kirk made about 150 tracks from 1929 onwards, of which less than a third are readily available at the present time.

Although the Clouds of Joy are generally considered to be a Kansas City band, they had a unity and personality of their own. Their music was more smooth and delicate, more advanced and sophisticated than the other Mid-Western bands. The riffs, the relaxed swing, the reluctance to move beyond a medium-fast tempo and their basic reliance on the blues, however, were typical of Kansas City.

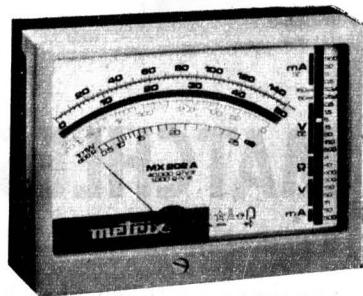
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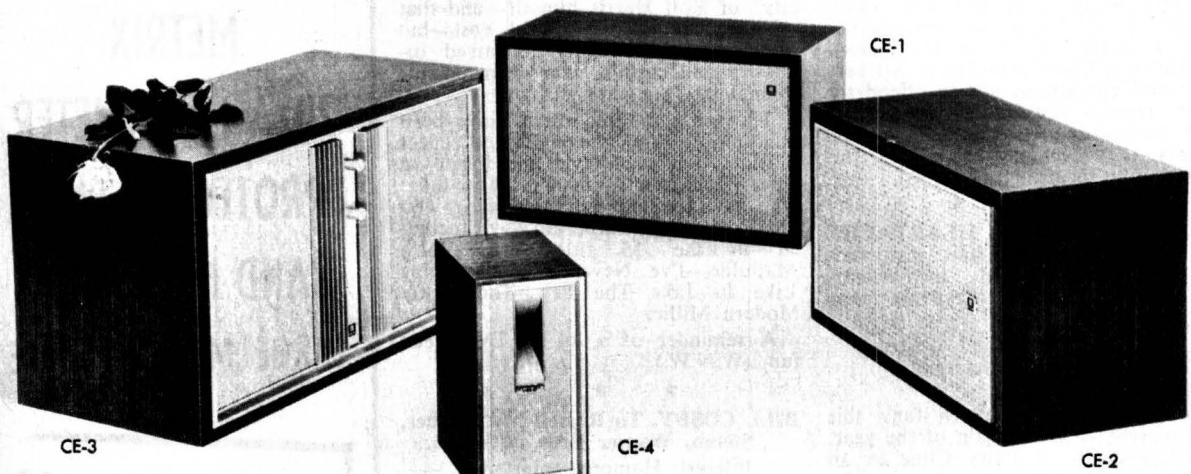
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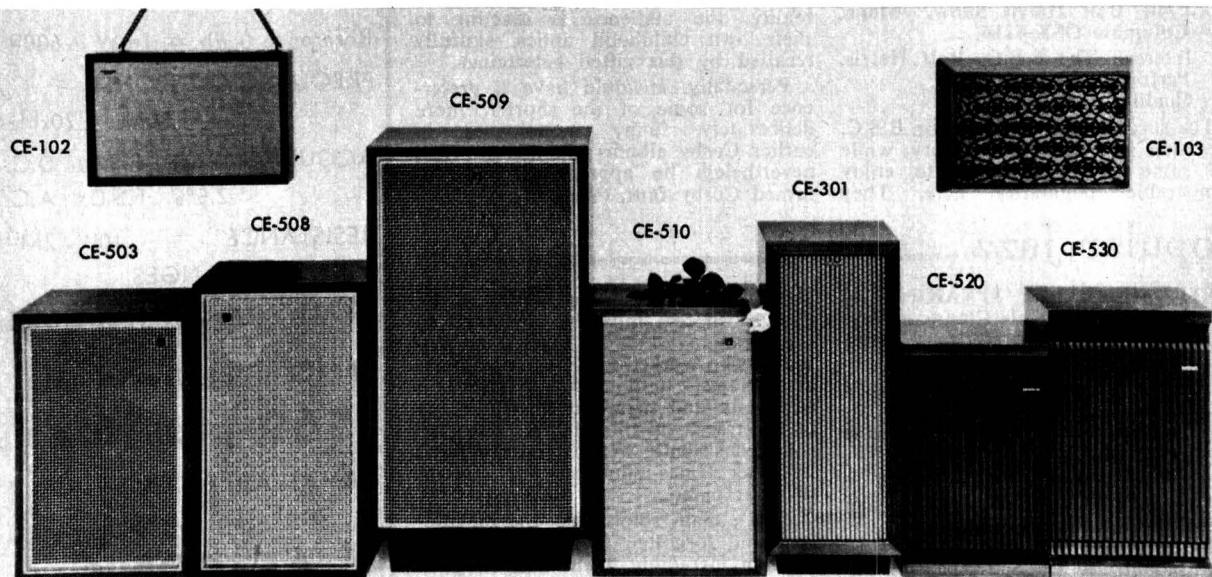
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LIVE AT THE CHEVRON—Graeme Bell and his All-Stars. Calendar (Festival) Mono R66-280.

Interest: Australian traditional jazz.
Performance: Enjoyable.
Quality: Good for location recording.

Over the years, no musician has done more for Australian jazz, both here and overseas, than Graeme Bell. (As I write this, Graeme is in England working with the Terry Lightfoot Band.) His greatest period was, of course, in the late 1940s and early 1950s when his world-famous band included men like Roger Bell, Ade Monsborough and Pixie Roberts.

But his various All-Stars of the 1960s were also first-class. In particular, Bob Barnard (trumpet) and Ken Herron (trombone) were musicians of genuine stature and on this album they both play some interesting solos.

This session was recorded live in June, 1964, during Graeme's tremendously successful residency in the Oasis Room of the Chevron in Sydney. The jazz purists may have objected somewhat to Graeme's showmanship and commercial leanings, but I personally enjoyed myself on the many occasions when I heard the band there.

This was a fairly typical Bell set with several vocals, including Barnard on "Just a Gigolo," Herron on "Shine" and clarinetist Graham Spedding on "Sweet Georgia Brown"; two Ellington instrumentals "Rockin' in Rhythm" and "Caravan"; two Lu Watters' compositions, "Irish Black Bottom" and "Emperor Norton's Hunch"; and two of Graeme's own pieces, "Balthazar" and "Mollie the Monk."

With the cheap reissue price of \$2.95 and a playing time of over 41 minutes, it can safely be recommended to all traditional jazz fans who might have missed it when it first appeared in 1964. (T.F.C.).

CRY YOUNG—Ahmad Jamal with voices. Chess Records (CBS) Stereo CHLS 247.

Interest—Only for Jamal enthusiasts.
Performance—Undistinguished.
Quality—Good, bright recording.
Stereo—Normal separation.

Since 1958 (his Pershing album) the 38-year-old Ahmad Jamal has been a reasonably big name on the American jazz scene.

Despite the public praise of him by people like Miles Davis and Ralph Gleason, however, his playing has never really stirred me. The impression of flaccid, effete, rather tinkly piano which I gained from his records was confirmed when I saw him at San Francisco's Basin Street West in 1965. Even in person his playing lacked impact, involvement and personality.

Record producers these days seem to be unable to resist "dressing up" the work of jazz musicians with large string orchestras, big bands and now vocal groups. The results are not particularly successful. Whenever Jamal does begin to build a good idea he is invariably interrupted by the angelic twitterings of the singers.

Some of the tunes, like the title track and "Who Needs Manhattan," both by Bob Williams, "There Are Such Things" and Jamal's own "Little

Ditty" are interesting but the overall impact of the album is paper-weight.

Jamal is competently backed by Jamil S. Nasser on bass and Frank Gant on drums but the album would have been so much better without the twenty voices.

The playing time is 35 minutes and the sleeve notes (by a Cincinnati D.J. called Jerry Thomas, "your friendly neighbourhood record player") are ludicrous. I'm glad I don't live in Cincinnati. (T.F.C.).

* * *

THE GEORGE GOLLA GUITAR PLAYS ON THE CENTRE LINE. Festival Stereo SFL-932684 (also in mono).

Interest—Modern guitar.
Performance—Superb musicianship.
Quality—Well recorded.
Stereo—Normal separation.

Sydney guitarist, George Golla, is one of Australia's leading session musicians, spending much of his time recording film backgrounds, commercials and TV and radio shows.

He also happens to be one of the finest jazz guitarists in the world today—personally, I would place him in the top six.

While he has been featured on the

majority of recent Australian jazz records, this long-overdue album is the first under his own name. And it is absolutely first-rate.

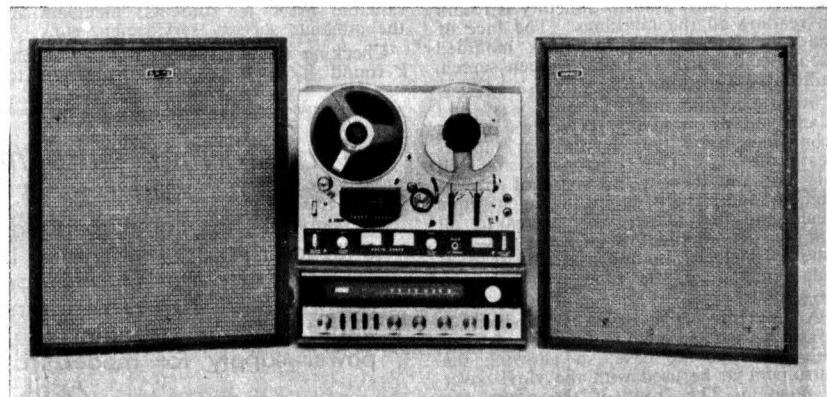
It is basically not an album of jazz material but rather a middle-of-the road set which only a jazz musician can produce really successfully.

Some of the tunes (e.g. "Winchester Cathedral," "Guantanamera") may seem a little outdated but it should be remembered that the album was recorded around the middle of 1967, its general release being held up by production difficulties.

George multi-tracked his parts using both electric and acoustic guitars and he is backed throughout by a first-class rhythm section of George Thompson (bass) and Derek Fairbass (drums). John Sangster is added on percussion for several tracks while Errol Buddle's majestic tenor and oboe can be heard on "Can't Buy Me Love," "Maria" and "Sunny."

But the most beautiful track on the album is "The Girl Next Door" which is a solo guitar feature for George Golla.

Any reader with the slightest interest in modern guitar playing should make a point of hearing this thoroughly enjoyable album, which runs for 36 minutes. (T.F.C.).



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TRADE REVIEWS AND RELEASES

Inexpensive oscilloscope from Watkin Wynne

Messrs Watkin Wynne Pty. Ltd., have just released a small oscilloscope, similar to what has been supplied to students of Technical Training International. The quantity is limited at the current price: \$72.00, plus tax, which amounts to \$81.00 for instrument and carrying case.

First impressions on unpacking this instrument are very favourable. The unit is well packed and the outward appearance compares favourably with a piece of professional equipment. The case is painted in grey brocade and is generously provided with ventilation holes. A neat, cast carrying handle adds a finishing touch.

The front panel is finished to match the case. All terminals and controls are marked by engraving. Although the engraving is small, it is in keeping with the size of the panel and no difficulty is found in reading all the markings. The face of the tube is fitted with a black moulded escutcheon, which includes a green screen, calibrated in centimetres.

Access to the inside is quite easy and is effected by removing six screws on the front panel and one at the rear, underneath the case. The components are well laid out and there is no sense of crowding. In fact, there is more than ample space and this allows easy access to all components, should this be necessary. The tube is shielded and the assembly is such that removal of the tube would be an easy matter.

A vinyl protective cover is provided. It is also perforated with holes to match up with those in the case, so allowing the instrument to be used with the vinyl cover in position. The front of the cover can be laid aside, for access to the front panel, by undoing a zip fastener.

Overall dimensions are 10½in long x 9½in high x 5½in wide. This is relatively small and makes the unit easily portable. The weight is just under 11lb.

A look at the specification shows that it is quite conventional but to give some idea of its performance, here are some of the details:

The cathode-ray tube is a 2in type 50HBI. Five valves include two 6X4 rectifiers, one 6AU6 vertical amplifier, one 12AT7 sweep oscillator and one 6U8 horizontal amplifier.

The vertical amplifier has a quoted gain of 32dB and a frequency range of 10Hz to 100KHz, at the 3dB points. The input impedance is 500K, with 40pF capacitance. Vertical deflection sensitivity is 1.0 volt peak-to-peak per centimetre. By means of a switch on the front panel, the amplifier can be by-passed and the signal fed directly to the deflection plates. This enables frequencies up to about 30MHz to be handled. Sensitivity under these conditions is 33 volts peak-to-peak per centimetre.

The horizontal amplifier has a gain of 33dB, with a frequency range and input impedance the same as the vertical amplifier. The sensitivity through the amplifiers is 1.17 volts peak-to-peak per centimetre, and 35 volts peak-to-peak per centimetre, direct.

The sweep oscillator covers from 15Hz to 30KHz, in six ranges. An additional

range for TV is quoted as covering from 4 to 10KHz.

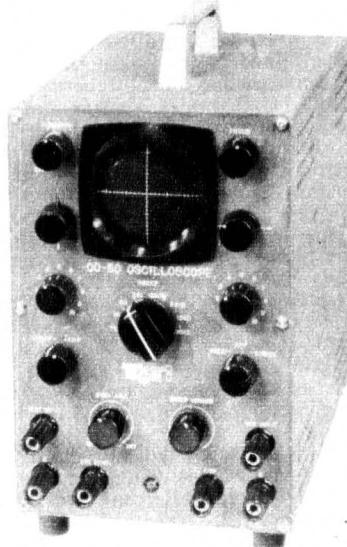
From these figures, a good idea can be had as to the capability of the unit. Essentially, it is an audio instrument, dictated by the frequency response and sensitivity of the vertical amplifier. However, with a response of 100KHz, quite a lot of wave-forms may be checked, including some encountered in TV work. Within this limit, many functions can be performed and the unit would be a valuable asset to students, members of the amateur service, servicemen, etc.

Checking this instrument on the bench, I found it to be easy and pleasant to

handle. Although the tube face is only 2in diameter, it is sufficient for most purposes. The trace is clean and the linearity of the sweep oscillator very good.

A comprehensive handbook is supplied, which gives the circuit and all other information which may be necessary. Method of operation, along with helpful hints as to some of the applications, are also included.

Further details may be obtained from, or orders may be placed directly with, Watkin Wynne Pty. Ltd., 32 Falcon Street, Crow's Nest, N.S.W., 2065 (I.L.P.).



Transformer suits model train controller

A sample has come to hand of a power transformer with characteristics which make it suitable for use in the construction of power supplies for model train layouts. Although not identical with that originally specified in our article, it would be quite suitable for use in the construction of the power supply for model trains described in our issue of April, 1968.

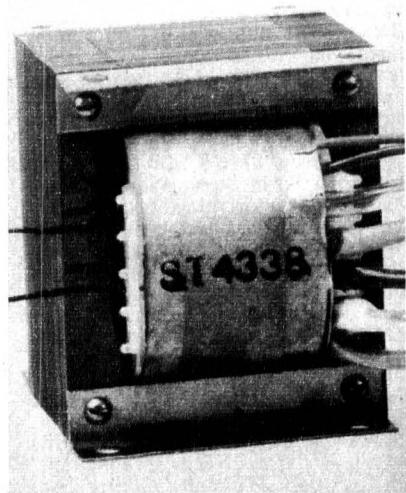
Following the description of a model train controller in the February, 1968, issue, and an associated power supply in the April, 1968, issue, we were advised by Special Transformers Pty. Ltd. that they had available a general purpose step down transformer with characteristics somewhat similar to the one used in the original power supply. They suggested that it might make a suitable alternative.

They accordingly submitted a sample for our inspection and we agree that it appears to be eminently suitable for this application. It is slightly larger than the original unit, but it can be accommodated in the sloping panel case we prescribed for the original power supply, although some slight rearrangement may be necessary.

The transformer is rated at 3.5A continuous, or up to 6A intermittent. These ratings should be more than adequate for any model train requirements. The voltage tappings, as measured on the sample submitted, were as follows: 10.5, 12.5, 15, 18, 21.5, 25. These were measured with a 3A drain applied to the full winding.

Heavy insulation is used both between windings and between the windings and the core. The latter is provided by a heavy gauge, high insulation plastic bobbin. No terminal board is provided, but there is adequate lead length to suit any likely wiring configuration. The leads are colour coded. Mounting feet are fitted.

Type number of the transformer is ST6338 and further details can be obtained from the manufacturers: Special Transformers Pty. Ltd., 139 Sydenham Road, Marrickville, N.S.W. 2204. It should be available through normal trade outlets and the price is quoted as \$11.25 retail (P.G.W.).



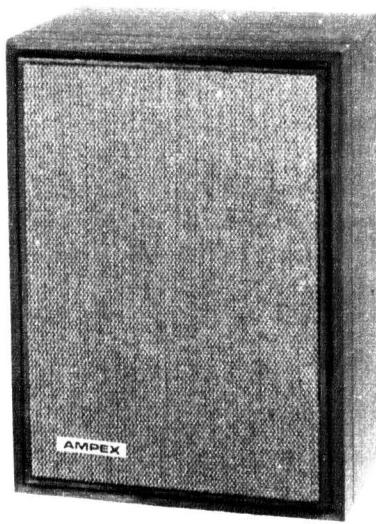
COMPACT LOUDSPEAKERS FROM AMPLEX AUSTRALIA

In the October, 1967, issue, more or less incidental to a review of the Ampex 2163 tape recorder, we made very favourable mention of the type 830 loudspeaker units which accompanied it. Measuring $15\frac{1}{2} \times 13\frac{1}{2} \times 9$ inches, the 830 loudspeakers would group with the larger compacts and earned comment along the lines "very clean, sound, smooth over the entire audible range . . . excellent definition . . . one of the most promising of the compact systems we have heard."

It was with considerable interest, therefore, that we received for review a pair of their smaller counterparts, type 815. Measuring $13\frac{1}{2} \times 9\frac{1}{2} \times 7\frac{1}{2}$ inches, the 815 systems have about the same internal volume as other current "bookshelf" units and use a similar combination of loudspeakers, a 6in woofer and 3in tweeter with cross-over network. The enclosure is filled internally with low-density fibre-glass.

Rated power handling capacity is a generous 15 watts RMS, and rated frequency response from 50Hz to 15KHz. The unit is available only with an impedance of 8 ohms.

Manufactured in the U.S.A., the 815 enclosure is of solid walnut timber, with an oiled non-glossy finish and has a subdued buff-coloured fret cloth contained



in a slightly protruding frame. The finish is very tasteful.

On a listening test, the 815 units performed substantially as we have come to expect from this now well-established formula for a compact system. Sensitivity was about average for the class and the response clean and wide. The bass taper-

ed away smoothly, without sign of doubling at normal power, so that use can be made of modest bass boost from the amplifier.

Compared with our prototype Playmaster "Point-4" system, the 815 showed a trifle more weight in the bass and middle register and a trifle less sparkle in the high treble—differences which might invoke personal preferences either way and which, in any case, would yield to slight manipulation of the tone controls. We would have no hesitation in commanding them to anyone in the market for a system of this type and price.

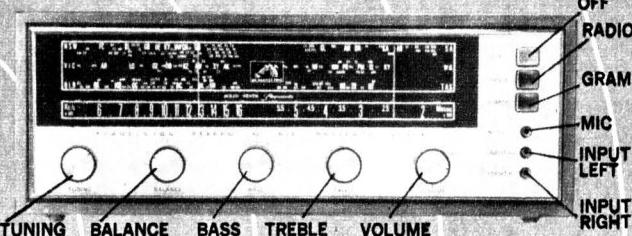
Consumer price for the 815 systems is \$85 per pair, including sales-tax. The units are available ex-stock and through Ampex dealers in all capitals and other major cities. (W.N.W.)

BASIC RADIO COURSE

"Basic Radio Course" is a quarto-size 128-page book published by "Electronics Australia." In its 24 chapters, it starts from first principles and goes on to explain the operation of radio transmitters and receivers. It introduces the reader to test equipment, audio systems, radio servicing, amateur radio and tape recording. Copies may be obtained by writing to "Electronics Australia," Box 2728, G.P.O., Sydney, 2001. Enclose postal note, money order or cheque for \$1.60, which includes postage.

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\$74.50

TWENTY-FOUR HOUR CLOCK MOVEMENT

Simplex International Time Equipment Pty. Ltd., have sent for inspection a sample of their standard 24-hour clock movement.

The unit uses a totally enclosed motor operated from 200-250V mains supply, rated at about 3W. Open type gearing is used, but the company points out that the gearing can easily be enclosed if required by the user. Other operational details are:

Second-hand spindle: 1 r.p.m.

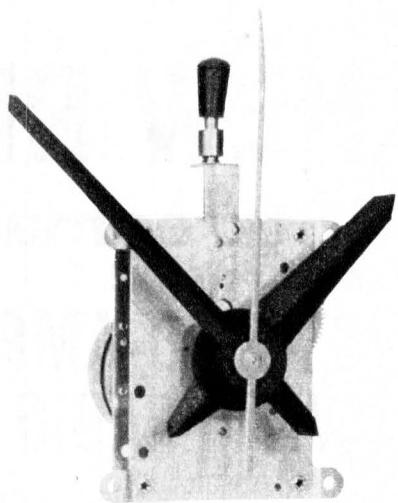
Minute-hand spindle: 1 r.p.h.

Hour-hand spindle: 1 rev. per 24 hours.

Mounting: by means of four screws.

Resetting: by means of reset shaft behind dial.

Hands: Optional, and supplied if required.



The basic Simplex 24-hour clock movement. Hands are optional, and must be ordered separately if required. Note the reset knob, which is normally out of sight behind the dial.

The company has forwarded this sample as a result of our 24-hour clock construction project in the June, 1968 issue and have suggested that this movement could be used by those who do not want to go to the trouble of modifying a 12-hour movement in the manner described in our article.

We have examined the movement and found it to be a robust, solidly constructed unit, quite suitable for the purpose envisaged. The once-per-24-hours travel of the hour hand is obtained by gearing.

The basic clock movement may be purchased directly from Simplex International Time Equipment Pty. Ltd., 53-63 Buckingham Street, Redfern, N.S.W. 2016, or from the company's branches in all capital cities. The price of the movement is \$17.65. Simplex advise that they also can supply a range of complete 24-hour clocks fitted with cases and dials. Details and prices of these units can be obtained from the company at the above address.

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PORTABLE VIDEO RECORDER FROM SONY

The Sony CV-2100CE Video Tape Recorder and its associated components form a complete medium-cost portable videotape system designed for industrial, educational, promotional, training and domestic applications. Based on the two-head helical scanning technique and using $\frac{1}{2}$ in wide tape, the system has features which would permit non-technical users to obtain and display recordings of consistent high quality.

A sample CV-2100CE recorder is pictured, together with a CVM-51UETP Monitor Receiver and a CVC-2100ACE camera with CVF-4CE electronic viewfinder and elevator tripod. Not shown but also supplied as part of the system are a low impedance microphone and stand, a comprehensive set of interconnection cables, and a sturdy carrying case for storage and transport of all the smaller elements of the system. The equipment was sent to our office for testing and review by the Australian agents for Sony, who are Jacoby Mitchell and Company Pty. Ltd.

The CV-2100CE recorder is a fully solid-state unit employing some 68 transistors and 34 diodes. It provides up to 40 minutes continuous recording on 2,370-ft spools of $\frac{1}{2}$ in tape, the tape speed being 11.5ips. The twin video heads rotate at 1500rpm, recording each video field on an oblique track approximately 8.65 inches long with an effective writing speed of slightly more than 430ips. Claimed video bandwidth is 3MHz, with a resolution of 240 lines on our 625 line system; video signal-to-noise ratio is quoted at better than 40dB.

Dimensions of the unit are 18-1/8in x 11in x 15-1/4in, with a weight of 55lb 2oz. The case is finished in two-tone grey leatherette, with extruded aluminium bracing; the deck and front panel are in metallic black. Power requirements are 110W at 50Hz, at a voltage adjustable from 100V to 240V.

The CV-2100CE may be used either for recording "live" with a camera and microphone, or for recording "off air" using a receiver such as CVM-51UETP. Video requirements are for between 1 and 3V P-P at 75 ohms unbalanced, with negative sync. polarity. The audio requirements are for either "mic" input at 0.7mV/600 ohms (-65dB), or "line" input at 100mV/100K (-20dB). Overall audio response is quoted as 80-10,000Hz, with better than 40dB signal-to-noise ratio and less than 5 per cent T.H.D. at 1KHz.

Video output of the recorder is quoted as 1.4V P-P at 75 ohms, unbalanced and with negative sync. Audio output is 1V (0dB) unbalanced, at 10K impedance from the "line" output. Multiple inputs and outputs are provided for both video and audio, a combination connector being used for interconnection with the CVM-51UETP receiver/monitor. All signal and power connections to the recorder are made at the rear of the case.

Few controls are provided on the CV-2100CE control panel, the accent being placed upon simplicity of operation. The main control is a three-position function lever coded "Play-Stop-Rewind"; a secondary lever provides the fast forward spooling facility. A locking pushbutton is provided for recording, while a two-position button is used to select the source of recording signals (TV/auxiliary or camera). A three-digit tape position indicator is fitted, and there is a recording level meter which may be switched to indicate either video or audio level.

A small inset panel on the right-hand side of the unit provides recording level controls for video and audio. The video

level control also has a push-pull action which provides a "standby" facility to permit single-frame replay.

Also on the side inset panel is a "Manual-AGC" switch, which draws attention to the fact that besides the provision for manual setting of video and audio recording level, the CV-2100CE is fitted with circuitry which adjusts both automatically if desired. This should be found a most attractive feature among less technical users, as it will tend to ensure

is housed in a sturdy carrying case which matches the recorder, contains the CVC-2100ACE Video camera, its tripod, the microphone and the complete kit of interconnection cables — all in compartments well laid out for convenience and protection during transport.

The CVC-2100ACE is a compact solid-state camera based on a standard high-sensitivity 1-inch Vidicon camera tube, and employing some 30 transistors and 20 diodes. It measures 4-1/2in x 5-5/8in x 10-7/16in (excluding lens), weighs 7lb 5oz, and accepts standard C-mount TV or 16mm cine lenses.

Three alternative modes of operation are provided: "VTR," in which the camera derives its sync. from the recorder and supplies the latter with video at 75 ohms; "Video," in which approximately 1.4V P-P video is available at 75 ohms via a co-axial connector (unbalanced, and with sync. negative); and "RF," in which a video modulated VHF carrier is available at the same connector (6mV/75 ohms). In



near-optimum recordings under a wide range of conditions.

The recording level meter is disabled in the "AGC" mode of operation. Although the manufacturer gives no reason why this is so, a likely reason is that the optimum recording levels as determined by the AGC circuitry — probably on an instantaneous peak basis — may not always correspond to the "optimum" indication on the meter. A green indicator lamp is provided to ensure that the operator is aware that the AGC circuitry is operational.

Concealed beneath a sliding panel adjacent to the recording button are two auxiliary buttons used for sound dubbing and picture editing. Using these buttons it is possible to replace either sound or picture (or both) components of existing recordings, as desired.

The CV-2100CE recorder differs from some other portable helical-scan VTRs, in that during "live" recording from the CVC-2100ACE camera, the sync. for the camera is derived from the recorder rather than vice-versa. This is an important feature, because it allows re-recording of scenes in existing recordings with a minimum of disturbance to synchronisation; also it permits the use of multiple cameras, mixing and effects units, and interconnection of recorders for tape duplication.

The VCK-2100ACE Video Camera Kit,

both the "Video" and "RF" modes the camera derives its vertical sync. from the AC power line, while the horizontal system is free-running to produce "random" interlace.

The VHF signal produced in the "RF" mode may be tuned by a preset control over a range covering Australian channels 1 and 2 (European CCIR channels 3 and 4).

The CVC-2100ACE is fitted with automatic sensitivity circuits which have a rated control range of 100-50,000 lux. To allow operation above or below this range

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AU70 Deluxe Turntable with 4 pole shielded motor, counter balance arm, micro lift, cueing device, anti-skate, on platform.

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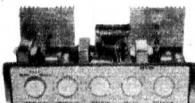
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Distortion 1% of 1%. Frequency response 30 cycles to 18Kc. Output 15
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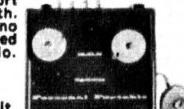
4½, 6 or 9 volts. Replaces transistor battery power input 240 volts A.C. Maximum millamps 100. Hum-free operation. Size 3½in l. x 2½in w. x 1½in h. No. 657, \$6.50 (post 10c).



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 - No. 461 to match 200 pf gang. Price \$4.50
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4 transistors, 1½ or 1 watt. Small size, cabinet 3in x 2in x 1in plastic. Suitable crystal P./up, intercom, microphone, radio, etc. (9 volt).



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SIZE 3 x 2 x 1in 2 req. for Stereo. LOW IMP. Input 2 trans. 672C \$6.50 Wired ready for use. 672D . . . \$8 HIGH IMP. silicon 3 tran. 682C \$8 Wired ready for use. 680D . . . \$8 HIGH IMP. silicon 3 tran. 682C \$8 Wired ready for use. 682D . . . \$9.50 Postage 10c each. Write for data.

when necessary, a beam current control is accessible for screwdriver adjustment. Similar provisions are made for adjustment of the electronic focus of the Vidicon.

Rated horizontal resolution of the CVC-2100 ACE for the VTR and Video outputs is better than 450 lines for 625 line operation, while the corresponding figure for the modulated VHF output is 300 lines. Rated signal-to-noise ratio is better than 40dB.

A most worthwhile feature of the CVC-2100ACE camera is a protection shutter, which covers the Vidicon target in the "Off" and "Standby" positions of the three-position function switch. This allows the camera to be left for long periods in bright illumination without risk of damage or "burn-in"; it also permits the changing of lenses in similar conditions.

An optional accessory for the CVC-2100ACE is the Electronic Viewfinder type CVF-4CE which attaches to the top of the camera in a few moments. Deriving video and sync. information from the camera via a small multi-way connector fitted into the camera top, the CVF-4 provides a sharp and bright monitor picture measuring approximately 3½in across a diagonal. Small controls are provided to allow independent adjustment of the picture brightness and contrast.

The CVM-51UETP Monitor Receiver is a compact solid-state unit providing a 9-inch diagonal picture. It employs some 29 transistors and 12 diodes, and has an aluminised 90 degree kinescope. Both VHF and UHF tuners are fitted, the former covering European CCIR channels 2-11 (Australian channels 0-2 and 6-11), and the latter European UHF channels 21-69. Rated maximum sensitivity for 10V P-P video at the kinescope is 10uV.

The receiver is fitted with a retracting rod aerial and a jack for external 75 ohm aerials. Power requirements are either 23W maximum at 220V AC or 15W maximum at 12V DC.

Video and audio connections to the CVM-51UETP are made via an 8-way connector fitted to the side of the case. Video input and output is at 1.4V P-P, 75 ohms unbalanced and with negative sync. Audio input is at 1V/5K, while audio output is at 100mV/10K. Accessories provided or available for the receiver are an external aerial connector, the VTR connection cable, a kinescope screen viewing hood, a protective front cover, an earphone and a polishing cloth.

Dimensions of the CVM-51UETP are 9in x 9½in x 8½in, with a weight of 10lb 2oz. The receiver is finished in black and grey, matching the VTR and camera.

Tested in our laboratory, the Sony VTR system performed substantially as claimed. Although it would be no means easy to verify rigorously the manufacturer's claims for video bandwidth and signal-to-noise ratio, tests made on the sample VTR using a frequency wedge test card suggested that the overall bandwidth was more than 2.6MHz, with the signal-to-noise ratio a little less than 40dB.

The picture was without excessive smear, was stable and free from weave and jitter. The audio performance equalled or exceeded the ratings. The "still" or stop-motion replay facility was not entirely satisfactory on the sample unit tested, it proving difficult to obtain a clean single frame; however this may vary from unit to unit, and is in any case of minor importance.

The controls of the recorder are such that, particularly in the AGC recording and the replay modes, operation is extremely simple and virtually fool-proof; the unit would thus appear ideal for use by unskilled personnel. The VTR sync. system also appears to work very well, and a number of inserted video recordings which we made caused virtually no sync. disturbance on replay — a most desirable state of affairs.

A minor disappointment was that the recording signal cannot be monitored on the CVM-51UETP before recording, unless the recording button is depressed — causing the video heads to rotate. Hence unless the camera is fitted with the optional (and by no means insignificantly priced) CVF-4 viewfinder, setting-up may be performed only at risk of causing wear to the stationary videotape in contact with the video heads.

The sample CVC-2100ACE camera and CVF-4 viewfinder tested gave an impressive performance, with resolution and signal-to-noise apparently very close to the rated figures. The picture produced was clear and stable, and the automatic sensitivity control seemed well able to cope with a variety of lighting conditions.

As with the camera and viewfinder, the CVM-51UETP Monitor Receiver performed impressively both "off air" and for VTR replay. Sensitivity was excellent, although in our city location the rod aerial limited performance rather seriously.

To summarise our assessment of the Sony VTR system, then, I would make the following points for and against:

Points we liked: The AGC circuits, which permit effortless yet high-quality recording; the VTR camera sync. system, which permits video re-recording, use of multiple cameras and effects units, and tape duplication using two machines; the carry-all case housing the camera, tripod and connecting cables; and the protective Vidicon shutter on the camera. The lack of a "tracking" or "phasing" control also simplifies replay.

Disappointments: The inability to visually monitor the recording via the CVM-51UETP, unless the video heads are rotating in contact with the tape; the lack of a cable permitting direct video connection of the camera to the monitor receiver for simple CCTV use (the RF output can be connected to the aerial terminals,

admittedly, but a direct video link would be capable of far better performance); the rewind is very slow — 7 minutes for a 2370ft tape. And a minor point — the poor performance of the sample machine on single picture replay.

Prices (retail) quoted for the various elements of the Sony system are as follows. Type CV-2100CE recorder, \$895.00; type CVC2100ACE camera, \$420.00; type CVF 4CE viewfinder, \$199.95; type CVM51UETP monitor receiver, \$420.00. Spools of tape are available at \$29.00 for 1,240ft (20 minutes recording) and \$46.00 for 2370ft (40 minutes recording). Further inquiries may be directed to Jacoby, Mitchell and Company Pty. Ltd., at 469-475 Kent Street, Sydney. (J.R.)

New Premises for RCA

RCA OF AUSTRALIA PTY. LTD. has occupied new premises situated at 11 Khartoum Road, North Ryde, N.S.W. 2113, and with this move has combined all its activities under one roof. Inquiries for all RCA equipment should in future be addressed to the relevant division at the above address.

Errata and Notes

AUDIO SIGNAL GENERATOR (December, 1967). In the wiring diagram, the connection from the junction of the 39K, 330K and 5.6K resistors to the 50K pot has been omitted. The connection should be taken from the bottom part of the twelfth strip from the left.

P.A. AMPLIFIER POWER SUPPLY (June, 1968). A transistor type number is given incorrectly in both circuit diagram and the parts list as AY6018; it should read AY6108.

BUY RECORDING TAPE AT WHOLESALE PRICE

WILCOX BROS. & BARCLAY

are now offering their line of recording tape direct to the Public at wholesale prices. This is a leading American manufacturer's first-grade line especially packed for us in a plain box. We are not allowed to reveal the maker's name.



TYPE	CODE	LIST PRICE	Wholesale PRICE
5" 900ft Acetate PVC	5R9	\$2.75	\$1.80
5" 1200ft Tensilized Polyester	5P12	\$4.45	\$2.95
7" 1800ft Acetate/PVC	7R18	\$5.10	\$3.35
7" 2400ft Tensilized Polyester	7P24	\$8.35	\$5.50

Wholesale prices allow for 33 1/3 per cent trade discount and cash settlement discount and include sales-tax. Freight free throughout Australia.

MONEY BACK GUARANTEE

WILCOX BROS. & BARCLAY tape is guaranteed to be first-grade splice free recording tape made in the U.S.A. Your money will be refunded in full on return of goods within fourteen (14) days if you are not fully satisfied with your purchase.

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NAME:

STREET AND NO.

CITY OR SUBURB:

POSTCODE:

PLEASE SHIP:

..... rolls 5R9 at \$1.80. Total \$

..... rolls 5P12 at \$2.95. Total \$

..... rolls 7R18 at \$3.35. Total \$

..... rolls 7P24 at \$5.50. Total \$

I enclose cheque/postal note/ Money Order for Total \$

Return this order to:

Wilcox Bros. & Barclay

WHOLESALE MERCHANTS

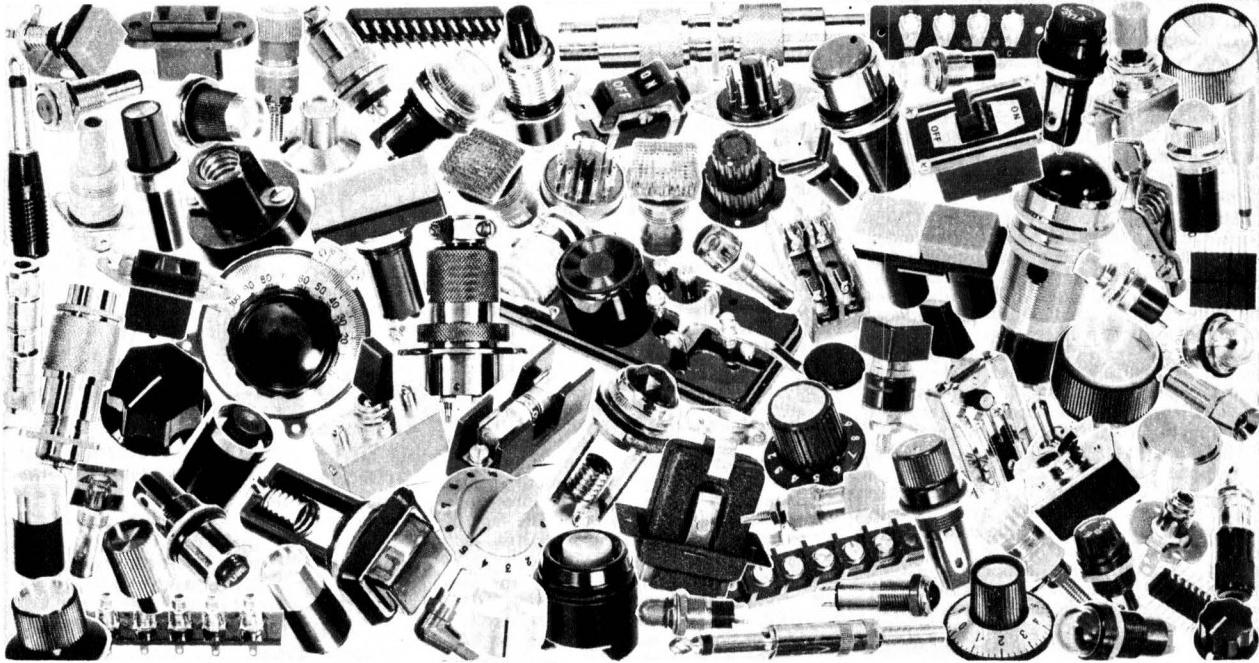
Mail Order Office:

Room 7, 3rd Fl., 323 Bourke St., Melbourne



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PU-54 Pick-up LP/45 only. Length 1.25mm .	Ea. \$2.10
Y400 Crystal Cartridge. LP/45 .	\$1.20
Y130 Crystal Cartridge. T/O Type Ster/LP .	Ea. \$2.70
Sapphire Replacement Styl. Each Ster/LP .	30c

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2 station 1 master 1 slave .	\$20.00
3 station 1 master 2 slave .	\$22.50
4 station 1 master 3 slave .	\$30.00
5 station 1 master 4 slave .	\$35.00
7 station 1 master 6 slave .	\$50.00
Complete with cable and batteries.	
3 station, all master .	\$36.00
4 station, all master .	\$48.00
Complete with batteries.	
Suitable cable from 20c yd. Plus 50c postage.	

SUB MINIATURE I.F. TRANS. 7 x 7mm. In sets of 3. \$2.00 per set	
OSC. COILS. 7 x 7mm. To match I.F. Trans.	70c each.
5K Sub-Min Pots. W/switch .	65c

PIEZO MICROPHONE INSERTS	
MC-3 Crystal, 50-7K, 35 x 25 x 8mm. -57 DB	\$1.00 ea.
MC-7 Crystal, 100-7K. 39mm Round x 11 mm. -56 DB	\$1.00 ea.
MC-8 Crystal, 50-8K. 48mm Round x 17mm. -50 DB	\$1.00 ea.
MC-9 Crystal, 50-8K, 25mm Round x 9mm. -68 DB	\$1.80 ea.
MC-33 Crystal, 50-10K, 33mm Round x 9m. -60 DB	\$1.30 ea.
MD-5 Dynamic, 100-15K. 33mm Round x 14mm. -55 DB	\$1.80 ea.

TRANSISTOR SET ACCESSORIES

Magnetic Earpiece with 3.5mm Plug .	75c
Crystal Earpiece with 2.5mm Plug .	75c
Crystal Earpiece with 3.5mm Plug .	75c
5in Spools .	40c
Jacks, 2.5 and 3.5mm .	20c
3.5mm Plug and Cord Ext. Jack Pair .	50c
Metal Co-axial Plugs and Line Sockets .	65c
Pr. "Din" and "Hirschmann," 2, 3, 4 and 5-pin Plugs, Chassis and Line Sockets, carried ex stock.	
Prices on application.	
P.M.G. type Plugs from .	50c
P.M.G. type Jacks from .	35c
P.M.G. Line Jacks from .	55c

Capacitor Substitution Box, 1,000 VW .	\$5.00
Resistor Substitution Box, 1 Watt. Plus Post, 20c. .	\$4.50

TRANSISTOR AERIALS	
4in extends to 27in .	\$1.60
5in extends to 39in .	\$1.70
6in extends to 43in .	\$1.40
6in extends to 32in .	\$1.00
6in extends to 28in .	\$1.00
7in extends to 39in .	\$1.20
9in extends to 39in .	.95c
6in extends to 4ft 6in .	\$1.80
7in extends to 5ft 8in .	\$2.10
Plus Post 15c. .	

CRYSTAL SET BUILDERS	
Coils .	65c
Diodes .	35c
Headphones .	\$2.50
Tuning Condns. .	\$2.00
Terms .	Ea. 12c
Plus Postage. .	

KEW METERS	
MR-2P 0-1 m/A	\$3.95
MR-2P 0-50 u/A	\$5.00
MR-2P 0-100 u/A	
MR-2P 0-500 u/A	\$4.00
MR-2P 0-500 u/A	\$4.50
MR-2P V.U.	\$5.80
Balance .	\$5.25
MR-2P 0-20v D.C. .	\$4.30
All Meters in clear plastic cover. .	

Meter .

TAPE RECORDER ACCESSORIES

2½in Spools .	30c
3in Spools .	35c
5in Spools .	40c
5¾in x 1,200ft .	\$3.10
7in Spools .	70c
7in x 1,800ft .	\$5.10
7in Spools .	50c
7in x 600ft .	\$2.35
7in Plastic Tape, boxes .	60c
7in Plastic Tape, boxes .	90c
Plus postage .	

STEREO PLUGS AND JACKS

Metal Plugs .	95c
Bakelite ext. sockets .	70c
Metal ext. sockets .	65c

O.T.A. SWITCHES (Rocker Type)

S.P. Changeover 1A .	45c
D.P. Changeover 1A .	50c
S.P. On-Off 1A .	50c

TOGGLE TYPE

SP On-Off ½in Long Neck .	60c
SP On-Off Short Neck .	50c
SP Change-Over Centre-Off .	75c
DP ST On-Off .	50c
DP DT ½in Long Neck .	80c
DP DT Short Neck Centre-Off .	75c

Bulgin — Push-On — Push-Off DP Change-Over for Fuzz Box, Etc. .	\$1.70
With fine pins .	55c
With Alligator Clips .	55c
With Banana Plugs .	60c
With Battery Clips .	50c

MAIL ORDER SPECIALISTS

TRADE RELEASES-IN BRIEF

CHANNEL MASTER DIVISION of Ferris Bros. Pty. Ltd. have introduced a new solid state TV distribution amplifier, Model SDA-30. The company says that under favourable conditions, the amplifier can supply up to 100 TV receivers. Brief technical data are:

Gain: 30dB max.

Coverage: All TV channels, 0 to 11, including 5A.

Frequency response: 40 to 225MHz ±3dB.

Flatness of response: Less than 0.5dB per channel.

Noise figure: Low band, 3.5dB.

High band, 4.5dB.

Max. input: 50mV.

Max. output: 1.5V.

Impedances: Output, 75 ohms; input, 300 or 75 ohms.

Retail price of the Model SDA-30 is \$89 including sales tax. Further information can be obtained from the company head office at 752 Pittwater Rd, Brookvale, N.S.W. 2100.

SOANAR ELECTRONICS PTY. LTD. have moved into larger premises located at 82 Carlton Terrace, Summer Hill, N.S.W. 2130 (phone number 789-6999) and all inquiries should be sent to that address. Soanar are agents for A & R transformers and electronic equipment, Elma capacitors and potentiometers, I.T. & T. diodes, Westinghouse rectifiers and Ercel tapes.

AMALGAMATED WIRELESS VALVE CO. PTY. LTD. has available a Guide to RCA Semiconductor Products, a 44-page publication listing essential characteristics of RCA transistors, diodes, rectifiers, thyristors and integrated circuits (linear and digital). The company also has data sheets for the following RCA developmental types: TA7149, TA7189, TA-7262, MOS field-effect transistors for VHF TV receiver application; TA7311 to TA-7316, moulded-silicone plastic power transistors; TA7364 and TA7365, gate-controlled full-wave silicon triacs. Copies of these publications may be obtained by writing on company letterhead to Amalgamated Wireless Valve Co. Pty. Ltd., 348 Victoria Road, Rydalmere, N.S.W. 2116.

MASTER INSTRUMENTS PTY. LTD. has developed a new range of moving coil panel meters for use in communications test and control equipment, laboratory test instruments, TV and radio transmitters and in panels for industrial process control. Known as the FB 50, the meter has been designed following a study of the problems encountered by equipment designers and packaging engineers in the application of panel meters to modern equipments. It was developed after months of design consultation between the company's design department, a design consultant, and many customers in the electronics and communications fields. The main features of the FB 50 are:

Dial emphasised for easy reading.

Suitable for multi-scale applications. Satin finished polycarbonate bezel to reduce reflection. Available in grey or black.



Master Instruments FB 50 meter movement.

Taut-band or jewel and pivoted suspension.

Self-shielding core magnet movements. Accuracy to Class 1 ASC42.

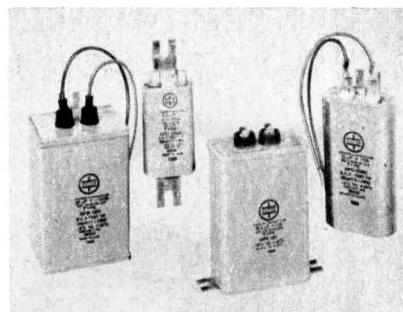
The makers say the movement meets the need for a meter permitting maximum conservation of panel space and simplicity of mounting. A single bracket accessible from the top makes mounting and access to remove the meter a simple matter. The mounting bracket will also accommodate lamp assemblies for effective illumination through the translucent spacer portion of the case assembly. The overall bezel dimensions are 5in x 3in. The proportions are intended to allow maximum scale area for accurate multi-function instruments. The unit can be mounted either in front of or behind the panel.

For further details, contact Master Instruments, corner Sloane and Saywell Streets, Marrickville, N.S.W., 2204.

DUCON DIVISION of Plessey Components has advised that its entire range of power factor improvement capacitors, produced under the new industry standard BS.4017, has been approved by the Sydney County Council after 12 months of exacting testing.

Plessey is the first Australian-based manufacturer to have been granted this class of approval. The entire range has been approved for operation at 85deg.C.

Introduced in 1966, the BS.4017 specification is much broader in scope than earlier specifications in that it covers capacitors up to 1KVAr and 1,000 V.A.C.W. 50Hz. To enable Ducon customers and lighting and consulting engineers to specify the range of capacitors covered by BS.4017, testing arrangements were made with the Sydney County



Part of the range of power factor improvement capacitors made under BS.4017 by Ducon Division.

Council. The test period took 12 months, due to the large number of samples required to cover the full scope of the BS.4017 specification. Final approval was given by the S.C.C. after a detailed inspection of the Ducon plant at Villawood and its quality control and manufacturing processes.

To give design engineers within the lighting industry the utmost flexibility in their approach to lighting until design, Ducon offers capacitors in either extruded aluminium cans with Argon Arc welded lids, or lock seam tinplate cans covered by the generic types APD, GPA, GPB, GPC and GPE. These capacitors provide a range of can sizes and bracket configurations to satisfy the most difficult application and all carry BS.4017 approval. The capacitors are impregnated with a synthetic that ensures non-flammability. Terminations are provided in quick connect, screw, or straight leaded types.

Further details can be obtained from Ducon Division, Plessey Components, Box 2, Villawood, N.S.W. 2163.

Dear Music Lover, What is a pick-up for?

These days it is not unusual to read through an advertisement for a high quality pick-up head without finding in it the word "music." Some people must wonder whether these pick-ups are built solely for the playing of "frequency records." However, the major consideration in all aspects of the design and manufacture of M.B.H. pick-ups is the quality of the end result—music. Every M.B.H. head has the usual readings taken on various frequency records as a matter of routine; but before an M.B.H. head gets as far as that, it must pass a listening test with different types of music. The music test is decisive, if the head does not pass this, any measuring tests are only in the nature of a post-mortem.

High compliance, low stylus mass, good frequency response, etc., do not automatically bring musical excellence. A subtle balancing between all factors, found only by trial and error, puts in the finishing touches, whilst the measured performance may remain much the same. Pick-up design and manufacture is still more art than science.

After listening to the most expensive imported Stereo pick-ups, we have no hesitation in saying that the Stereo M.B.H. "L" series sounds better musically. A bold statement indeed, but one you can check without instruments.

And of course we forgot to mention! The M.B.H. (Harris) pick-up is Australian made and has been tested against the world's best.

Write today for a technical brochure and price list. Then we hope you will try one because the price is right too.

Yours Sincerely,

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430 Elizabeth Street Melbourne, Vic. 3000. Phone 34-6539



PATON Power Analyser

an extremely accurate, versatile, low-cost
TRUE DYNAMOMETER INSTRUMENT
that manufacturers have found invaluable!

MEASURES

Volts, amperes, watts.
Power factor—kVA and kVAR (reactive).

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A.C. volts 0/125-250-500
A.C. amps. 0/2-5-20
A.C. watts 9 ranges (3 for each voltage range)

PLANT MAINTENANCE and general trouble shooting, electric motor testing, etc.

PRODUCTION TESTING refrigerators, washing machines, air conditioners and all other motorised appliances.

POWER FACTOR CORRECTION. Quickly and accurately detects low power factor—the most common cause of costly electrical waste.

SEALED REFRIGERATION unit diagnosis.

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Vic.: 469 King Street, Melbourne. 329-8873

Agents:

QLD.: K. H. Dore & Sons, Brisbane.
W.A.: Henderson Instrument Co. Pty. Ltd., Perth.
S.A.: E. Brown Pty. Ltd., Adelaide.

TAS.: George Harvey Electric Pty. Ltd., Launceston and Hobart.
N.Z.: Turnbull & Jones Ltd., Wellington and branches throughout N.Z.

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'ELECTRONICS AUST.', 'MULLARD', 'MINI-WATT'*

KITS COMPRIZE ONLY COMPONENTS AS CALLED FOR IN RESPECTIVE PUBLICATIONS.

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FOR KITS

any project from

MULLARD 3-3 VALVE STEREO	\$71.50	PLAYMASTER 117 60 WATT GUITAR AMPLIFIER	\$82.50
MULLARD 10-10 AMPS.	\$103.50	(Electronics Aust. July, '67)	
1966 R.C. BRIDGE	\$38.50	PLAYMASTER 118 STEREO AMPLIFIER	\$82.40
(Electronics Aust., May '66)		(Electronics Aust. July, '67)	
VACUUM TUBE VOLT METER	\$55.00	PLAYMASTER 115 SOLID STATE STEREO AMP.	\$99.00
(Electronics Aust. Feb., '66)		(Electronics Aust. April, '67)	
HIGH IMPEDANCE MIXER	\$32.80	PLAYMASTER 120 HYBRID CONTROL UNIT	\$47.30
(Electronics Aust. Feb., '67)		(Electronics Aust. Feb., '68)	
LOW IMPEDANCE MIXER	\$28.80	RF TEST OSCILLATOR	\$40.50
(Electronics Aust. Feb., '66)		(Electronics Aust. March, '68)	
PLAYMASTER 106—STEREO AMP AND TUNER	\$99.00	VARI-TACH MOTOR SPEED CONTROL	\$21.75
(Electronics Aust. Dec., '63)		(Electronics Aust. March, '66)	
PLAYMASTER 111 WIDE BAND TUNER	\$45.00	TRAIN CONTROLLER WITH SIMULATED INERTIA	\$14.75
(Electronics Aust. Oct., '65)		(Electronics Aust. March, '67)	
PLAYMASTER 116 40 WATT GUITAR AMPLIFIER	\$79.40		
(Electronics Aust. June, '67)			

THE ABOVE PRICES INCLUDE SALES TAX. FREIGHT FREE WITHIN AUSTRALIA.

Two prices in Magrath's July advt. appeared incorrectly, they should have been "Radar Solid State Inverter" \$26. "Radar 05X Power Supply" Unit \$15. Both Sales Tax and Postage paid.

J. H. MAGRATH & CO. PTY. LTD.
208 LT. LONSDALE STREET, MELBOURNE, VICTORIA, PHONE 663 3731

VARIAN PTY. LTD. has introduced a new line of frequency multiplier diodes known as Super Power Bimode diodes. These are claimed to offer a 3dB power improvement over the company's standard series of Bimode diodes. The new diodes are said to offer complete static characterisation, plus guaranteed dynamic performance. Details may be obtained from the Electron Tube and Device Group, Varian Pty. Ltd., 38 Oxley Street, Crows Nest, N.S.W. 2065.

PLESSEY PACIFIC PTY. LTD. announce the following appointments:

Dr W. A. S. Butement, C.B.E., has accepted a directorship with the company, for which he is at present Director of Research. Dr Butement was the first chief superintendent of the Woomera rocket range, and instrumental in the development of internationally renowned guided weapons such as the Ikara anti-submarine and Malkara anti-tank systems. Before World War II he made major contributions in the fields of radio and radar.

Mr W. Fielder-Gill has been appointed to the new position of group production executive with the responsibility for co-ordinating all manufacturing aspects of the Plessey Pacific group of companies. Until recently, Mr Fielder-Gill held the position of management development executive for the group. Prior to his appointment to headquarters staff in 1966, he was executive engineer for the Telephone and Electrical Industries (T.E.I.) Division, where he headed a 200-man engineering department.

NATIONAL CASH REGISTER CO. is now marketing in Australia a magnetic tape encoder with communications logic which is said to introduce a new degree of versatility into the field of data transmission. The Model 1102 Magnetic Tape Encoder/Communicator transmits business information at high speeds to another 1103 over telephone lines. The transmission rate can be adjusted from 600 bits per second up to 1600 bits per second. When not being used for data communications, it can be used as a magnetic tape encoder to prepare computer inputs. Inquiries to the company at 14 York Street, Sydney, N.S.W. 2000.

EMERSON AND CUMING INC. Canton, Massachusetts, U.S.A., has developed a new syntactic urethane foam designated Eccofoam VIP. Supplied as two components which are mixed, cast and cured, the resulting product is said to be tough, low in density, low in dielectric constant, and unicellular. It is intended for use for potting electronic components and circuits and as an electrical surface coating. Inquiries to the Australian agents, Wm. J. McLellan, The Crescent, Kingsgrove, N.S.W. 2208.

TYREE INDUSTRIES LTD. informs that preparations for a proposed new transformer plant are well advanced and operations are expected to begin early in 1969. The company plans to spend about \$1 million on construction of the first stage of the factory at Liverpool and the

Australian agents for Vega Wireless Microphones

We have been asked by Simon Gray Pty. Ltd to point out that they are the Australian national distributors for Vega Wireless Microphones, which were described recently in "Electronics Australia" (March, 1968, page 121). Inquiries for this item may therefore be addressed to the company at 22 Ridge Street, North Sydney, 2060, or to the head office at 28 Elizabeth Street, Melbourne, or to the company's branch offices and interstate distributors.

purchase of new equipment. In addition, much of the valuable existing plant and equipment will, in due course, be transferred to these premises. The company plans to sell all three existing factories in Sydney over a period and move progressively into the new installation, which covers a 30-acre site.

Endurance Electric Pty. Ltd., a subsidiary company recently purchased from W. R. Carpenter and Co. Ltd., will be transferred from its present Gladesville factory during this year and be incorporated in an extension of the Liverpool factory. Endurance has been producing high and low voltage transformers for metering and protection purposes and other allied equipment.

EMERSON AND CUMING INC., Canton, Massachusetts, U.S.A., has designed a thixotropic silicone paste—Eccosil TP-51 — for those applications where no flow is wanted before or during cure and high thermal conductivity is a requirement. It is supplied as a two part system — the parts are mixed in a ratio of from 10 to 1 up to 40 to 1 depending on the desired pot life and cure time. Eccosil TP-51 will bond well to itself or to other silicones. Inquiries to the Australian agents, Wm. J. McLellan and Co. Pty. Ltd., P.O. Box 69, Kingsgrove, N.S.W., 2208

SINGER PRODUCTS CO. INC. has announced the availability of two new ADC speaker systems. The Brookfield features 30-20,000Hz frequency response; high-flux, wide dispersion mylar dome tweeter for high frequencies; high compliance 6in and 10in drivers for mid and low frequencies; power is 10 watts minimum and 60 watts maximum. The Oxford has 40-20,000Hz frequency response, power 6 watts minimum and peak 60 watts music power; hi-flux magnet tweeter and 6in highly compliant piston cone woofer. Impedance of both systems is 8 ohms. For more information write to Electronics Division, Singer Products Co. Inc., 95 Broad Street, New York, N.Y. 10004, U.S.A.

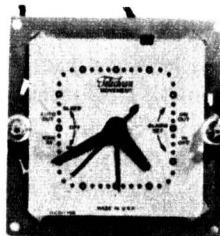
VARIAN TUBE DIVISION, Palo Alto, California, U.S.A., has developed a 35GHz klystron amplifier for use in millimetre-wavelength research, space-probe and communications applications. The fixed-tube produces a CW output of at least 1kW with a drive power of only 10mW. It is electromagnetically focused and liquid cooled. The bandwidth (1dB) is 30MHz. For further information write to Varian Pty. Ltd., 38 Oxley Street, Crows Nest, N.S.W., 2065.

NORTON CO., Vacuum Equipment Division, of the U.S.A., has developed a compact, direct reading vacuum gauge with a dynamic range of from ten million to one in a single sensor. Called the NRC 820 Alphatron vacuum ionisation gauge and control, the sub-atmospheric transducer uses a radium salt source rather than a reference cell to ionise gas molecules. Because of this, the gauge can measure and monitor the pressure range from one atmosphere to 0.1millitorr. The instrument has solid state circuitry and is temperature compensated to ensure rapid response and repeatable readings after long periods of continuous use. Further details may be obtained from Norton Australia Pty. Ltd., Nyrang Street, Lidcombe, N.S.W. 2141.

BLONDER-TONGUE LABORATORIES INC., Newark, New Jersey, U.S.A. has appointed Ad Auriema Inc. as exclusive export distributor for all the world except Canada. Blonder-Tongue manufactures master antenna TV distribution systems, closed circuit distribution systems, community and educational systems, laboratory test equipment including field strength meters and VHF/UHF generators, and associated home TV accessories. Inquiries to Auriema (Asia) Pty. Ltd., 443 Kent Street, Sydney, N.S.W. 2000. ■

"AMERICAN TELECHRON"

Clock-Alarm-Timer Movements



230v 50 c/s AC
Switch Rating 230v 7½ Amps

**NEW
WITH FACE & HANDS
\$4.00 each Post Paid
10 for \$32.00
Plus Freight**

**SPECIAL for 24-HOUR
UNIVERSAL CLOCKS
See Electronics Australia
June, 1968**

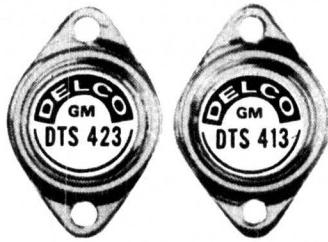
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\$3.00 each Post Paid
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JOLYON INDUSTRIES PTY. LTD.

25 McRAE PLACE,
TURRAMURRA,
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**All Movements completely
guaranteed**

A COOL 400V



Delco Radio's new DTS 413 and DTS 423 power transistors, are conservatively rated at 75 and 100 watts. Our standard TO-3 package assures low thermal resistance (junction to heat sink 1.0°C per watt) for cool power. The silicon element gives you high voltage protection, high frequency response and low saturation voltage.

The price is low (less than 3c. a volt for sample quantities) for two reasons: special inter-digitated geometry of the devices and our unique 3D* process for high yields.

Now you can reduce current, the size of other components, and increase efficiency in high energy circuits. Vertical and horizontal TV outputs, for example.

Your Delco Radio Semiconductor distributor has these two new power transistors on his shelf. Call him today for data sheets, prices and delivery.

*Triple sequential diffusion

RATINGS	DTS 413	DTS 423
VOLTAGE		
V _{CEO}	400 V (Max)	400 V (Max)
V _{CEO} (Sus)	325 V (Min)	325 V (Min)
V _{CE} (Sat)	0.8 (Max)	0.8 (Max)
	0.3 (Typ)	0.3 (Typ)
CURRENT		
I _C (Cont)	2.0A (Max)	3.5A (Max)
I _C (Peak)	5.0A (Max)	10.0A (Max)
I _B (Cont)	1.0A (Max)	2.0A (Max)
POWER		
	75 W (Max)	100 W (Max)
FREQUENCY RESPONSE		
f _t	6 MC (Typ)	5 MC (Typ)

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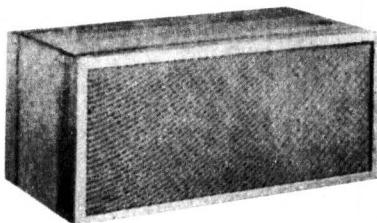
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TECHNICAL BOOKS AND PUBLICATIONS

TV servicing

PIN POINT TV TROUBLES IN 10 MINUTES. By Harold P. Manly. Stiff paper covers, 372 pages $8\frac{1}{2} \times 5\frac{1}{2}$ inches, freely illustrated with photographs, drawings and charts. Published 1967 by TAB Books, Blue Ridge Summit, Pa., U.S.A. Australian price \$6.15 or \$8.70 for the hard cover edition.

This book would appear to be written expressly for up-and-coming TV servicemen. The author assumes that the reader will already be familiar with the fundamentals and the language of electronics and with the nature of the relevant components. He therefore proceeds straight to the subject of TV troubleshooting, highlighted by a series of pictures showing the most common faults, as evidenced on the screen of the TV receiver.

The author then looks at length at typical television receiver circuitry, progressing from the antenna, tuner, IF amplifier and video detector, through the AGC circuit, video amplifier, etc., and on to the deflection circuit, the yoke and the power supplies. He explains the kind of circuitry that is used in the various sections, the faults that can occur, their effects and their cures. The style is terse, but well written nevertheless, and quite comprehensive. The material will apply well to Australian television receivers, provided allowance is made, where necessary, for the different scanning and frequency standards. Understandably, perhaps, no reference is made to colour receivers.

Interspersed with all this basic material are charts which aim to key the text to specific faults. Assuming that a particular fault is observed, the idea is to identify it with a condition depicted in the front of the book, then check through the references which suggest where to look for possible causes in the various sections of a receiver, and finally to check in the receiver itself. If the book title is to be believed, this procedure should take an average of 10 minutes!

Maybe one could learn to use the charts to proper advantage after a while but first impression of this reviewer was that the title was the brainchild of an optimist rather than a realist. Be that as it may, however, the book does contain a lot of useful information for the initiate serviceman, who could read it as a textbook first and treat it as a servicing guide later.

Our copy came direct from the publishers but supplies should be available through technical booksellers by the time this review appears. (W.N.W.)

Things to build

BENCH-TESTED COMMUNICATIONS PROJECTS. A Rider series book published by Hayden Book Co., Inc., New York. Stiff paper covers, 128 pages, $9\frac{1}{2} \times 6\frac{1}{2}$ in, freely illustrated with circuits and pictures. Price in Australia \$4.10.

Intended for use by electronics home constructors, this book contains some 26 projects or chapters selected from past issues of the magazines "Elementary Electronics" and "Radio-TV Experimenter." The description "bench-tested" draws attention to the fact that the projects have been built and tested; they are not just circuit ideas, which might or might not work.

Of the 26 projects one is a radio microphone that would be illegal in this country, four are related to CB equipment not used or licensed in Australia and one uses a super-regenerative detector couple directly to an aerial — the kind of gadget our airwaves can well do without.

Of the remaining projects, seven are presumably directed towards novice amateurs in the U.S., a couple of simple transmitters, a couple of ideas for housing and controlling amateur equipment, an electronic TR switch, a crystal calibrator, plus odd ideas which might be culled from the CB articles.

The more general features include a crystal set amplifier, a transistor RF preamplifier stage, an outrigger BFO, a couple of simple VHF converters and/or adapters, a service oscillator, a transistorised microphone "transformer" and a couple of housing gimmicks for radio receivers.

All told, it is not a collection that an Australian hobbyist could get very excited about but undoubtedly, some of the ideas would hit the spot for individual hobbyists. It's the kind of book that really calls for an individual decision.

Our copy came from Feffer and Simmonds Inc., 122 Castlereagh Street, Sydney 2000. (W.N.W.)

Electronic measurement

MEASURING METHODS AND DEVICES IN ELECTRONICS. By A. C. J. Beerens. Original Dutch edition, Philips, Eindhoven 1964. English edition 1966. Special English edition Hayden Book Co. Inc. New York, 1968. Stiff paper cover, $182 \text{ pp } 8\frac{1}{2} \times 5\frac{1}{2}$ inches, illustrated with line drawings and circuits. Price in Australia \$5.35.

One would expect a book to have merit, which has been sponsored in the first instance by the Philips organisation, and subsequently translated into German, French and English. And merit it certainly has.

Written for students, technicians and scientific workers seeking a familiarity with electronic measurement techniques, it is written in a concise style, which packs a lot of information into a limited space. It is not a difficult book to read but is one that will need to be read slowly to obtain proper benefit from it.

Part 1, covering the first 80 odd pages is devoted to Measuring Instruments. Chapter 1 deals with the moving coil meter and its extensions by means of rectifiers, thermocouples, etc. and its use with amplifiers to constitute millivoltmeters, and the familiar VTVM. Chapter 2 treats the oscilloscope and some of its extensions, while chapter 4 deals with signal generators RF, BFO and AF, the latter including square-wave output.

Chapter 4 deals with measuring bridges of various types, chapter 5 with frequency meters (including analog and digital) and chapter 6 with regulated power supplies, both DC and AC.

From page 81 onwards under "Part 2," the author turns to measuring methods. Chapter 7 is entitled "Measuring current, voltage, power and frequency." AC and DC are included and a variety of methods involving the equipment already examined in part 1.

Chapter 8 covers the measurement of resistance, capacitance and self-inductance, while chapter 9 is entitled "Measurements on passive networks." This

includes DC conductors, capacitors, inductors, resonant circuits, transformers and transmission lines.

Measurements on tubes and transistors is the subject for chapter 10 while chapter 11 is given over to active networks.

A brief final section, Part 3 and chapter 13, warns the reader about sources of error which can mislead the unwary. The book concludes with a general index.

Whereas most such textbooks tend to deal with fewer instruments at greater length, this one takes a broader view of test equipment and techniques and, as such, should be valuable in the hands of one who is prepared to study rather than merely read. Our copy came from Feffer and Simmonds Inc., 122 Castlereagh St, Sydney, 2000. (W.N.W.)

Inexpensive manuals

TRANSISTOR CIRCUITS FOR RADIO CONTROLLED MODELS. By Howard Boys. Paper covers, 60 pages $9\frac{1}{2} \times 7\frac{1}{2}$ in. Published by Bernards Radio Manuals, London, U.K. price 7/6.

MODERN TRANSISTOR CIRCUITS FOR BEGINNERS. By Clive Sinclair. Paper covers, 56 pages, $9\frac{1}{2} \times 7\frac{1}{2}$ in. Published by Bernards Radio Manuals, London, U.K. price 7/6.

The publishers of these two modest publications have been in the technical publications field for a long time in the U.K. and the guiding hand of their experienced general editor, Clive Sinclair, is evident in the clearly written texts and well laid out circuits and layout diagrams. Both books are entirely practical in character, theory matters having been left to other books. A glance at the abridged lists of publications on the back covers of both books indicates that this is a general policy of the publishers.

The radio control book appears to have been very successful in the U.K., having gone through eight editions since it was first published in 1961. As the title implies, the text covers only the electronic side of the hobby, the aspects of model design and construction being regarded as a separate matter entirely. This is another indication of the editor's determination to

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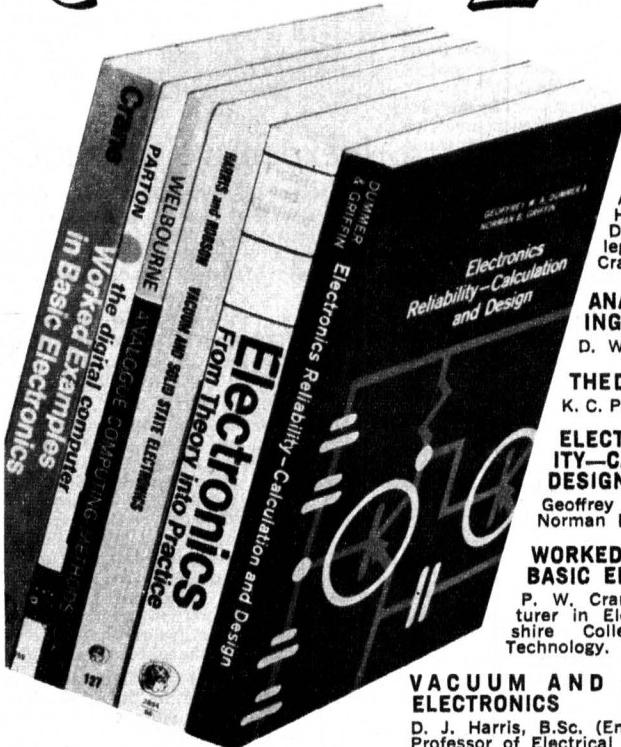
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stick to the subject matter exclusively, without digressing into other fields.

In general, the circuits have not been designed by the author, but have been collected by him, after having been well tried in the field by practical hobbyists. Full credits are given to the source in each case. In view of the age of the text, some of the circuits are definitely dated, and would not represent the present state of the art as practised by leading Australian modellers. Moreover, some of the transistors specified are now obsolete types, and it may be necessary to look for suitable substitutes in some cases. Nevertheless, in general, the book, as an introduction to the subject, contains much useful information for the model hobbyist, and presuming the U.K. price is some indication of the Australian price, represents good value for money.

"Modern Transistor Circuits for Beginners" was originally published in 1962, this being the fifth edition. The contents are not as general as the title implies, since it is devoted exclusively to battery operated broadcast receivers, using one, two or three transistors. There are three chapters, entitled: The components used in transistor circuits — Simple transistor radio circuits — Regenerative and reflex receivers.

The same basic components are used throughout the series of receivers described, so that experimenters can dismantle finished receivers and build up others without too much additional expense. Although the book was written some years ago, the transistor types are still current. However, the author appears to be connected with a British company which makes some of the components specified, and which may not be available here. It is unfortunate that performance data of these components are not given, as this omission will make it difficult to choose substitutes.

The discussion on components contains much useful advice for the beginner and covers the most common mistakes made through lack of experience. The remaining two chapters contain circuits for 35 receivers, each accompanied by a brief description and commentary. This is useful, but, in our experience, absolute beginners require rather more guidance in the practical construction aspects than are given here. Those who already have some construction experience should have little difficulty with these circuits.

The following publications from Bernards (Publishers) Ltd., uniform with the titles reviewed above, have also been received:

Practical Tape Recording Handbook, by Clement Brown, 47 pages, First published 1958. This edition published 1964. U.K. price 5/-.

Super Sensitive Transistorised Pocket Radio for the Home Constructor, by S. G. Ryder-Smith. Published 1961. 32 pages, with circuit, constructional details and parts list. U.K. price 3/6.

High Fidelity Loudspeaker Enclosures, by B. B. Babani. First published 1957. This edition published 1965. 46 pages, containing constructional details of 26 loudspeaker designs. U.K. price 5/-.

Our review copies came from H. W. C. Blyth and Co., 3 Kerferd Street, East Malvern, Victoria, 3145, from whom details of availability and local prices may be obtained. (H.A.T.)

* * *

ELECTRONIC CIRCUIT DESIGN HANDBOOK — Second Edition. Edited by George Rotsky. Published by TAB Books, Blue Ridge Summit, Pennsylvania. Hard covers, 11 x 8½ inches, 320 pages, many circuits and diagrams. Price in Australia \$18.70.

The first edition of this work was originally published in 1965 and reviewed in these columns in July, 1966. The second edition was reviewed in July, 1968. A further copy has been received from Feffer and Simmons Inc., 122 Castlereagh St., Sydney, 2000.

NEW ISSUE OF RADIO PARTS CATALOGUE

The latest edition of the catalogue produced by Radio Parts Pty. Ltd. has recently come to hand. This is much larger than the previous edition, and contains 370 pages in a sturdy plastic covered binder.

Through this illustrated price list, the company presents a most comprehensive range of parts and appliances in regular use in the radio, electrical and TV industries. New products are being added to the range, but will not be listed in this catalogue. However, those who join the amendment service will be advised of these items. Subscribers to the service will pay \$10 for two years and receive monthly advice on price changes, monthly advice on new lines, new pages when major price changes occur, monthly circulars and other advices. Extra copies of the catalogue cost \$2.50 each.

The catalogue is divided into three principle sections: radio and TV (260 pages), electrical (62 pages) and instruments (42 pages). Among the many items included in this list are aerials, amplifiers, batteries, cabinets, capacitors, phonographs and accessories, knobs, lamps, microphones, picture tubes, plugs and sockets, rectifiers, speakers, switches, tape recorders, tools, transformers, TV components, and wire.

The catalogue is available to the trade only, from Radio Parts Pty. Ltd., P.O., Box 124, North Melbourne, Vic. 3051.

ELECTRONIC ENGINEERING NOMOGRAMS. By Max H. Applebaum. Published by TAB Books, Blue Summit Ridge, Pennsylvania, 1968. Hard covers, 11 $\frac{1}{2}$ x 8 $\frac{1}{2}$ inches, spiral wire bound. Price in Australia \$12.40.

This useful collection of nomograms was reviewed in the July, 1968, issue, on page 127. A further review copy was received from Fetter and Simmons Inc., 122 Castlereagh St., Sydney, 2000.

NEW WAYS TO DIAGNOSE ELECTRONIC TROUBLES. By Jack Darr. Published by TAB Books, Blue Ridge Summit, Pennsylvania, 1968. Soft covers, 8 $\frac{1}{2}$ x 5 $\frac{1}{2}$ inches, 287 pages, many diagrams, circuits and photographs. Price in Australia \$4.95.

This book was reviewed in the July, 1968, issue, on page 127. A further copy was received from Fetter and Simmons Inc., 122 Castlereagh St., Sydney, 2000.

LITERATURE—in brief

MINIWATT DIGEST, Vol. 7, No. 3, March/April, 1968, includes the following articles: An economical 2.5W audio amplifier; Miniwatt silicon controlled switch BRY39; Operational amplifiers, part 4; New products — germanium power diode AYY10/120, FCJ121 dual JK flip-flop, silicon high voltage diode BYX35, and iron vane switched reed. Miniwatt Digest is published by the Miniwatt Electronics Division of Philips Electrical Pty. Ltd., 20 Herbert Street, Artarmon, N.S.W. 2064. The subscription rate is \$3 per volume (post free); single copies are available for 50c.

ATHOM NEWS is a periodical review of developments in the design, construction and application of scientific apparatus and instruments. Vol. 6, No. 3, April, 1968, includes the following articles: A new immersion cooler with new capabilities; On the reliability of Mettler balances; Specific ion meters; QAE-Sephadex, a fully quaternised ion-exchanger; The Radiometer titrigraph, its operating principle and some applications; Colora ultra cryostats; A battery operated constant-temperature anemometer; More about electrodes for measuring specific ions; Air sampling instruments in industry and mining; A miniature constant-current anemometer; Mettler F.P2 apparatus for micro-thermal investigations; Blood gas calculator; A revolutionary new recorder; Component linearity testing equipment; World sensation in medical science; Isotope abundance measurement; Routine analyses of Ca in serum.

Athom News is published by Andrew Thom Ltd., 261 Broadway, Sydney, N.S.W. 2007, to whom all inquiries should be addressed. Interstate inquiries may be forwarded through the company's interstate representatives, Watson Victor Ltd.

MULLARD TECHNICAL COMMUNICATIONS, Vol. 10, No. 91, January, 1968, has the following contents: VHF Transistor Transmitters for AM and FM Operating Directly from Vehicle Batteries; Mobile 166MHz AM Communications Receiver; Electronic Aerial Switch for Mobile Transceivers. Inquiries to Mullard-Australia Pty. Ltd., 35-43 Clarence Street, Sydney, N.S.W., 2000.

TELECOMMUNICATION JOURNAL, Vol. 35, No. 6, June, 1968, contains two studies on member countries of the International Telecommunication Union. In the first, S.E. Doyle describes the government and industry structure of communications in the United States. In the other, Y. Levi deals with the planning of Israel's telecommunication system and reviews planning activities for a 15-year scheme (1966-1980). In another article, N. Bininda and E. Hoffman, of Siemens (Munich) describe the basic principles of multi-stage link arrangements in switching systems.

The "Ideas and Achievements" feature includes information about the Barcelona-Pisa submarine coaxial cable, the first intercontinental automatic telephone link between Africa and Europe, and PCM developments. This issue reports on recent ITU activities, including the session of the administrative council and the election of a new deputy-secretary-general in Mr Richard Butler (Australia), the work of C.C.I.T.T. and C.C.I.R. study group meetings, and the activities of the technical co-operation department.

The Journal may be obtained from the Publications Service, International Telecommunications Union, Place des Nations, 1211 Geneva 20, Switzerland.

R. H. CUNNINGHAM PTY. LTD., have asked us to point out that the address of the company head office is now 608 Collins Street, Melbourne, and that the address given in these columns in last month's issue (8 Bronham Place, Richmond) is incorrect.

NEW DEVELOPMENTS, issue B036, May, 1968, the new products guide published by Jacoby, Mitchell and Co. Pty. Ltd., has descriptions of the following items:

Advance dual trace solid-state oscilloscope OS2000, dual trace oscilloscope OS25, and educational oscilloscope OS12; Jayem 5in oscilloscope 555, multimeter HB-100, and Micromegmet insulation tester JM-01;

Counting Instruments Ltd. micro-miniature in-line display series 70;

Siliconix Inc. differential FET pairs 2N5196 to 2N5199;

Weinschel variable coaxial line attenuators series 953/973;

Comark resistance meter 220 and Galvotron electronic galvanometer 200;

Alfred solid-state sweep oscillator 6151; Ad-Yu direct coupled impedance converter A1025;

Sanders F.H.P. speed controllers 5001 and 5002;

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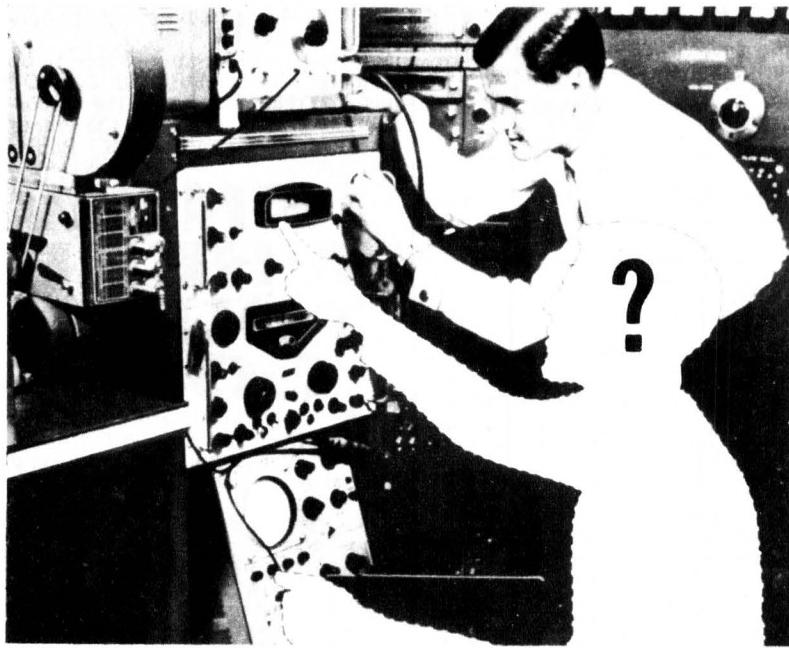
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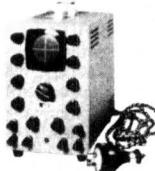
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PRD frequency measuring meters. Inquiries to Jacoby, Mitchell and Co. Pty. Ltd., 469-475 Kent Street, Sydney, N.S.W. 2000.

PLANAR, April - June, 1968, includes the following articles: A fixed gain low-distortion AF amplifier; Editor's note: "Would you believe 1984?" First LSI design kit; New products — three MOS shift registers and a high-speed compatible TTL hex inverter; The sales engineer; Clarification of IC noise margins. Inquiries to Fairchild Australia Pty. Ltd., 420 Mount Dandenong Road, Croydon, Vic. 3136.

TECHNICAL NEWS BULLETIN, May 1968, published by the U.S. National Bureau of Standards, has the following contents: International study of Laser wavelength; Panoramic X-ray machine reduces costs; Mossbauer effects aids studies of gauge block instability; NBS studies atmospheric gases; Standard reference materials; Welding technique for high-vacuum equipment; Standards and calibration; Data obtained on dielectric constant and loss factor of foliage; Estimating molecular weights of vinyl acetate copolymers in latex paints; Conference and publication briefs; NSRDS news; Publications of the NBS.

The Bulletin is available for an annual subscription of \$US2.25 (single copies US-15c) from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, U.S.A.

MULLARD OUTLOOK, Vol. 11, No. 3, May-June, 1968, includes the following: Viewpoint with Mullard; Linear ICs, their use in consumer products; New transistors for FM and UHF transmitters; Electronic aerial switch for mobile transceivers; Whiskerless diode for fast logic circuits; Phototransistor with wide field of view; TTL IC range expands; DTL or TTL — no need for confusion; Infrared detectors at work; Mullard non-linear resistors; Compact digital read-out with new numerical indicator tubes. Inquiries to Mullard-Australia Pty. Ltd., 35-43 Clarence Street, Sydney, N.S.W. 2000.

PHILIPS IN SCIENCE AND INDUSTRY, Vol. 13, No. 6 (a publication for industrial electronics and related fields) has articles as follows: The electronics industry, a many-sided aid in science and technology; Gas chromatography, principle and equipment; Stop-start gas chromatography; Canadian metal-diffusion research; The PW1250 automatic simultaneous X-ray spectrometer; Automatic emission spectrometry; Newly developed timers and counters for nucleonic instrument modules; Applications of the Philips 400 - channel pulse - amplitude analyser; The last word in automatic liquid-scintillation counting, the PW4510; The Philips automatic liquid - scintillation analyser; Electron microscope news; Thin-layer gauging on the beta back - scatter principle; Recent advances in pH — and conductivity measurement and recording; Cleaning of microfossils by means of ultrasonics; The sealed-off CO₂ laser; New products. Inquiries to Philips Electrical Pty. Ltd., Scientific and Industrial Equipment Division, 69-79 Clarence Street, Sydney, N.S.W. 2000.

NATIONAL BUREAU OF STANDARDS (U.S. Dept. of Commerce) has inaugurated a new announcement service called CAST (Clearing - house Announcements in Science and Technology) which is designed to provide information for quick review by the user. CAST is a method for the busy scientist, engineer and businessman to scan the flow of new technical information in any of 46 separate fields of technology that result from research. It will feature the latest comprehensive reporting of publicly available reports and translations. It will announce all report titles made available to the clearing house and provide abstracts or other subject information for each report. Subscriptions to CAST are now available at \$US6.25 for the first category and \$US6.25

INDUSTRIAL RELATIONS LECTURES

The Sydney University Chemical Engineering Association and the University of N.S.W. Chemical Engineering Association are jointly sponsoring a series of evening lectures entitled "Industrial Relations and the Commercial Enterprise." This series will follow the same general lines as previous lecture series entitled "Business Management" and "Law and the Industrial Enterprise."

The lectures will be held at Sydney University from 7 p.m. to 9 p.m. over a period of eight evenings, commencing on August 6, 1968. The fee for the course will be \$30. Additional information may be obtained from Mr Tim Hooke, C-Dow Corning Aust. Pty. Ltd., Box 115, P.O. Waterloo, N.S.W. 2017 (phone 69-8005).

for each additional two categories. For further details, sample copy and subscription order blank, write to Clearinghouse (410.61), U.S. Department of Commerce, Springfield, Virginia, 22151, U.S.A.

TECHNICALITIES, June, 1968, the new products magazine of Tecno Electronics Pty. Ltd. has descriptions of the following products:

Pacific Measurements Inc. log/lin RF power meter 1009;

Princeton Applied Research Corp. electrochemistry system 170 and polarographic analyser and recorder 171;

Radio Research Co. crystal controlled AM generator 72 and crystal controlled FM generators 38 and 39;

Measurements standard deviation meter 140, FM signal generator 560, and standard FM signal generator 95;

Specific Products standard frequency distribution systems SFD-6 and DAP-100, and standard frequency receiver SR7F;

The contributions of Edsel Murphy to the understanding of the behaviour of inanimate objects;

Lecroy Research Systems Corp. analog storage time to height converter 108HA, and digital discriminator 223;

New accessories for P.C.D. reader;

Rustrak Inc. recorders;

Gulton Industries microminiature ceramic capacitors D series, HF low-pass filters, and active low-pass filters.

F. W. Bell Inc. General purpose gaussmeter 600 and 600A;

Torr Laboratories Inc. vacuum relays;

C-Cor Electronics Inc. laboratory amplifiers;

Yaskawa high performance servo print motor JKPM;

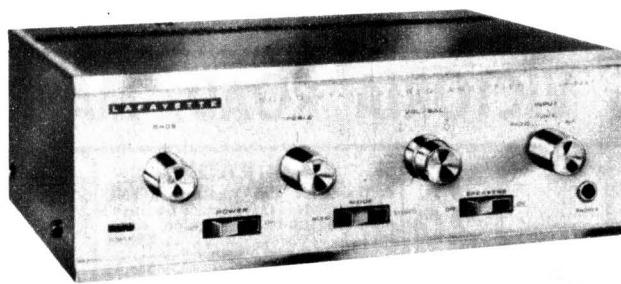
Pye Pty. Ltd. crystals.

Inquiries to Tecno Electronics Pty. Ltd., P.O. Box 12, Marrickville, N.S.W. 2204.

HEWLETT - PACKARD JOURNAL, Vol. 19, No. 9, May, 1968, includes the following articles: Sweeping four decades at low frequencies; Applications of low frequency sweepers; Easier and brighter display of HF signals; Stanford scientists study space signals. Inquiries should be addressed to Hewlett-Packard Australia Pty. Ltd., 22-26 Weir Street, Glen Iris, Vic. 3146.

EMERSON AND CUMING INC., Canton, Massachusetts, U.S.A., has produced a new brochure which briefly discusses the important features of 14 Eccosyn syntactic foams. Each is composed of small hollow glass, ceramic or plastic spheres in a plastic matrix. The matrix may be epoxy resin, RTV silicone, polyurethane, hydrocarbon or polyester. In form these products may be pourable liquids, free flowing powders, or mouldable compositions. A table lists the most important characteristics of use for each of the materials together with some of the physical and electrical characteristics of the system after curing. Inquiries to the Australian agents, Wm. J. McLellan and Co. Pty. Ltd., N.S.W. 2208.

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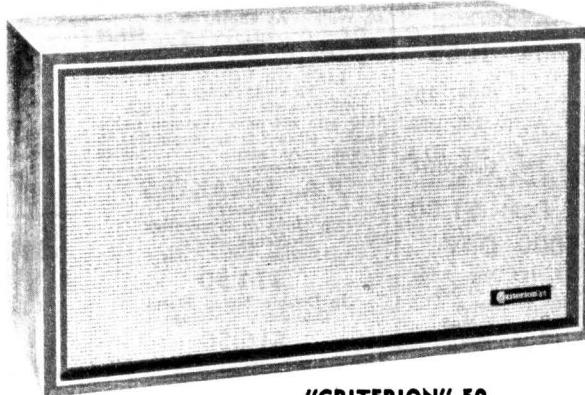


MODEL LA-224T

\$99.50

30 WATT SOLID STATE STEREO AMPLIFIER

A "Remarkable" value by any standards of comparison. All the characteristics of a quality Hi-Fi amplifier have been incorporated into the LA-224T. Attractive slim styling and 30-watts power supplied through the use of 16-transistors, 4 diode circuitry for instant, cool operation, low current drain, minimum distortion and noise, excellent frequency response. Suits speakers 4, 8 and 16 ohm impedance. SPECIFICATIONS — POWER OUTPUT: 30-watts IHF, 24-watts continuous. FREQUENCY RESPONSE: 30-20,000 cps + or - 2db. HARMONIC DISTORTION: Less than 1%. SENSITIVITY: (Mag. Input) 3mv; tuner/auxiliary 250mv. CONTROLS: Power On/Off, Spkr/Phones, Bass, Treble, Volume/Balance, Mode (Mono, Stereo). POWER REQUIREMENTS: 220/249 volts AC 50 cps.



"CRITERION" 50

\$45.50

2-WAY BOOKSHELF TYPE SPEAKER SYSTEM

Ideal matching speakers for the LA-224T amplifier. Offers impressive hi-fi sound, yet measures only 19"W x 8½" x 10½". 8" woofer plus 4" Tweeter in an acoustically "tuned" enclosure, fully lined, assures smooth, resonant-free sound, yet measures only 19"W x 8½" x 10½". 8" woofer plus 4" Tweeter in rubbed oiled walnut veneer tastefully framed in an ebony and gold picture frame moulding with white and gold acoustic grill material.

SPECIFICATIONS — 8" Woofer plus 4" Tweeter, "Tuned" enclosure with Tube-Type ducted port, Overall Response 35-18,000 cps, Power rating 20-Watts but efficient at low power, 3,000 cps Electrical Crossover.

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Division of Electron Tube
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LAFAYETTE Hi-Fi Equipment is also available from Selected distributors throughout Australia.

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**K
20
CT330**



**K
20
CT501**

C.T.330 20K. OPV

D.C. Volts 6, 6, 30, 120, 600, 1,200, 3,000, 6,000. A.C. Volts 6, 30, 120, 600, 1,200. D.C. Current 0.6-6, 60, 600mA. Resistance 6K, 600K, 6meg, 60meg. D.B. minus 20 to plus 62. 5 Ranges. Specially suitable for transistor use

\$15.95

C.T.500 20K.OPV

D.C. Volts 2.5, 10, 50, 250, 500, 1,000. A.C. Volts 10, 50, 250, 500, 1,000. D.C. Current .03, 5.50, 500mA. Resistance 12K, 120K, 1.2meg.. 12 mes. D.B. minus 20 to plus 62.

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KAMODEN—100B

100,000 O.P.V.
D.C. Volts .5, 2.5, 10.50, 250, 500, 1,000. A.C. Volts 2.5, 10.50, 250, 500, 1,000. Milli. .01, .25, 2.5, 25, 250, 1D.A Res., 20K, 200K, 2M., 20M:OHM DB minus 20 to plus 62. 5 Ranges.

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M.A. 1-100-500 RESISTANCE.

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200H. 20K.OPV

D.C. Volts 5, 25, 50, 250, 500, 2,500. A.C. Volts 10, 50, 100, 500, 1,000. D.C. Current .50A, 2.5, 250mA. Resistance, 6K, 600K. Capacitance, 2 D.B. Ranges.

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PANEL METERS



**EDGE METERS, 1mA.
Scaled V.U.S.
Tuning Stereo Bal. \$2.50.
A FULL RANGE OF UNITS.
85 Types. 1/4in to 3/4in.
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8 Transistor Car Radios. 12 volt. Long-range reception. De luxe model. Push-button station selector. Standard model, with speaker \$49.50 Standard aerial \$3.75 Lock-down model \$8.75

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MINIATURE P.A. AMPLIFIER.

15 WATTS OUTPUT. Multi Match Ferguson O.P. transformer input for crystal mike and pick-up with electronic mixing. P.P. EL-84 output \$39.50 30 Watt. As above. EL34 P.P. \$83.50 40 Watt. As above. EL34 P.P. \$79.50 60 Watt. As above 6DQ6 P.P. \$98.50

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8 WATT 8in Units in Waterproof Projection Horns. 15 Ohm Voice Coils.

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In Double Ended Flares. Dualateral Coverage.

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Line Output Transformers to suit. \$1.75 extra.

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Floor Model MIC Stand 2 Section Adjustable. Heavyweight.

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Mullard ACE, scaled for 5.7 or 9K. With Dwell Angle ... \$23.75 OHNAR 240-degree Circular Movement. Scaled 6K or 8K \$24.75 Standard Scale, 6 or 8K \$19.75 Postage N.S.W. 50c, Interstate 75c

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Latest design to suit organs, stereo, guitar, any hi-fi equipment.

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V.C. 16 ohm Cross over. 3,000 cycle. Frequency range 40 to 20,000 cycles.

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12in 20 Watt.

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HORN TWEETER CT-3

2,000-20,000 Response. 20 Watts Power. Sensitivity 110 dbw. Weight 14lb.

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Latest Model, 4-speed. \$28.75

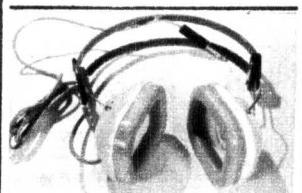
De Luxe Model. Fully machined and balanced. Heavyweight turntable. Ceramic cartridge.

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Range 25c to 17K.c.

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8 or 15 ohms.	
2in	\$2.75
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80m/m	7in x 6in \$5.95
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240V A.C. operation. 6V and 12V 10 Amp. Also Trickle Charging.

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Spec. AC.V. Inv.—300 Vrms. 10 ranges. Accuracy 5 cps—1 2 mc. plus-minus 2dB. 10 cps—1 mc. plus-minus 1dB. 20 cps—250 KC. plus-minus 0.2dB. dB. Scale: 40-30-20-10.0. 10.20. 30.40. 50 dBm. 240 V.A.C.

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Special: Semi-finished Stromberg Organ Cabinets to suite above.

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Aust. made. 8 or 16 ohms.

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Most popular brand.

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"MYERS" AUTOMOBILE STEREO TAPE PLAYER

Power Supply: 12V DC (Rated Power requirement less than 1.0 ampere.)
Cartridge Tape: Size 3
Cartridges of both 4 and 8 track. Playback Head: 4 and 8 track compatible, automatic starting and automatic channel selecting. Transistors: 12-transistor (Silicon-used and OTL system). Tape Speed: 3-1/4" per second, plus 3% minus 1%. Drive Motor: DC Micro motor with Governor.
Frequency Response: 70—10,000 cps. Wow and Flutter: Less than 0.3% WRMS (when using standard tape). Separation (Cross Talk): Better than 45db. Signal to Noise Ratio: Better than 40db. Price \$99.50. Also available for 240V A.C. Operation only. Includes Pick-up or Radio Inputs. \$99.50.



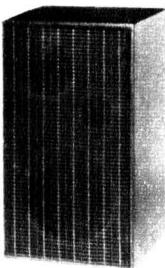
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SUPER BOOKSHELF \$36.75.

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CABINETS ONLY
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BOOKSHELF UNITS
 6in 8in 10in 12in
 \$27.75 \$33.50 \$35.50 \$36.50



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10-Watt, Two-Channel, with Twin Cone Speaker \$53.55
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35 WATT

4-Channel, Bass and Treble Boost, 4 Twin-Cone Speakers \$109.05
 Vibrato with foot control and 2 preset controls for frequency and intensity. \$10.50 extra on above models.

14 plus 14 WATT

With Reverberation. May be used as 28 Watt or as 14 Watt plus 14 Watt Reverb. Two 9 x 6 Woofer Speakers. Two 9 x 6 Twin-Cone Speakers. 4 Channels, Bass and Treble Boost. Foot Vibrato control included.

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SLAP BASS OR BASS GUITAR 40-WATT AMPLIFIER

4 Input Channels, Bass and Treble Boost. Two 12in Radial Beam Speakers. Perfect reproduction on 20 cycles.

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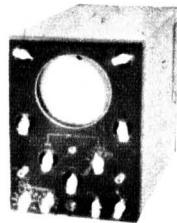
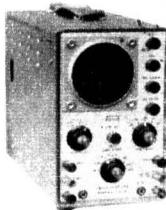
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30 Watt \$79.75
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 4 Inputs. Bass and Treble Boost. Vibrato if required. \$10.50 extra.

ELECTRIC GUITAR

Pickup Units \$8.75
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 Post. N.S.W. 40c; Interstate, 75c.

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5 Meg. Bandwidth Push-pull vertical and horizontal Amplifiers, 8 positions, high sensitivity vertical Amplifier, Frequency Compensated on all positions. Calibrated .02 to 600 volt. Hard time base, 20 cycles to 75K. Latest American R.C.A. circuitry. Complete with probe.

3-inch \$99.75; 5-inch \$111.50

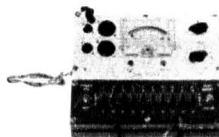
PLAYMASTER 115

The new solid state Stereo-Amplifier. April issue.
 Wired and tested \$104.00
 Kit Set \$90.00
 Pre-amp to suit magnetic cartridge 12.00



PLAYMASTER 118

KITSETS \$79.75.
 Wired and tested. \$89.75.
 Fitted with Pre-Amp to suit Magnetic Cartridge. \$12.00 extra



119 STEREO TAPE ADAPTER

Suits all Playmaster Stereo amplifiers and others that accept crystal P.U.

Kitset \$79.00

Wired and tested \$96.00

TAPE PLAYBACK KITSET

BSR deck with parts for transistor pre-amp and circuit.

\$30.00

Post \$1.25 N.S.W., \$2.00 Interstate.

Easy to build. Mi-Fi quality.

TAPE DECKS B.S.R.

2 Track, 3 1/4 I.P.S. **\$25.50**

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Tests all valves, diodes, rectifiers, checking filaments, shorts. Merit on direct reading. Good-bad meter. Complete with tube chart.

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Lender 810. 6-Band. 2 Mcs to 260 Meg Navistorized. 240 V.A.C. Operation. Modulated. Calibration. Accuracy 3 per cent.

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T.E. 18 Lafayette. 8 Bands. 360 K.C. to 260 Megs. 240 V.A.C. operation.

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AUDIO GENERATOR

De Luxe Model TE-22D. Freq. range. Sine 20 cps—200 Kc. SQ. 20 cps—25KC. Output voltage. Sine 7V. SQ. TV. P-P. Output impedance 1000 ohms. Acc. 5 per cent. Distortion less than 2 per cent. 4-range attenuation. 1/1, 1/10, 1/100, 1/1K. Printed circuit.

240V A.C.

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Transistorized. Fountain pen-sized Unit for Signal Tracer in Radio, TV and Amplifier Service. Price \$4.75.

PLAYMASTER 117

60-Watt

KITSETS \$90.75

Wired and tested. \$96.75.

SIGNAL GENERATOR

Deluxe Model TE-20D. Freq. range 120 KC—500 Mcs. 7 Bands. Accuracy 2 per cent. Output 8V. Provision for Xtal. Suitable for self calibration Marker generator. Printed circuit. 240 F.E.20 \$25.50. **\$27.50**
 V.A.C.
 Post.. N.S.W. 75c; I.state \$1.25.
 Leader L.S.G. II \$29.75.

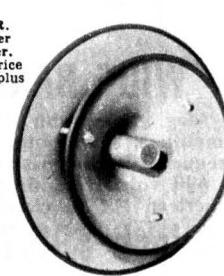
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Choose from an extensive range of Top Quality Unipex Speakers — including Combination and separate Driver Types.

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Horn Speaker.
Trade Price
\$22.70 plus
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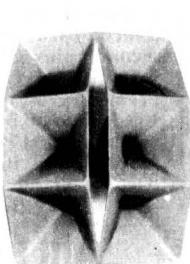
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Speaker.
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High Fidelity Coaxial
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SH.C. 6 Throat
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Aluminium
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One Driver
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Driver Units. Matching Driver Motors and Transformers available from 15 to 35 watts. All wattage R.M.S. Selective range of Sato. Bezels, Knobs, Fuse Holders, Key Switches, Terminals, etc.

A.S.T. Solid State Amplifiers available:—
3/5 Watts, 12/15 Watts, 30/40 Watts, 60/70 Watts,
100/120 Watts. All 100 Volt Line.
Manufacturers of most Comprehensive Language Laboratories to Victorian Education Department Specification.

Wholesale prices on application.

SPECIAL OFFER! Heavy duty "PRINCESS" RECORD PLAYERS, \$10 each plus Tax.

Australian Sound & T.V. Co. Pty. Ltd.

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Phone: 61 3024, 61 3192 (A.H. 288 3693)

COMPARE THE SPECIFICATIONS AND THE VALUE OF THE "COMPAX" COMBINATION!



COMPAX CE-5000 SOLID STATE STEREO TUNER/AMPLIFIER, \$169

Power Output: 40 watts R.M.S. total (80 watts I.H.F.M. total)
20 watts R.M.S. per channel (40 watts I.H.F.M. per channel)

Frequency response: 20-20,000 Hz. \pm 2 dB.

Harmonic distortion: Less than 1%.

Signal to noise: — 60 dB.

Input sensitivities: Magnetic pickup—3 mV.
Crystal pickup—50 mV.
Aux. input—150 mV.

Speaker impedance: 4-16 ohms.

Bass and treble controls: Each \pm 10 dB. at 100 Hz. and
10 kHz. respectively.

Dimensions: 16 $\frac{1}{4}$ " x 10 $\frac{1}{4}$ " x 5 $\frac{1}{2}$ ".

Tuner frequency range: 535 Kc. to 1605 Kc. Sens. 50 mV.
Tuner intermediate frequency: 455 Kc.

Features include scratch, loudness and rumble controls; the
external cabinet is beautifully finished in selected teak veneers.
The performance of this attractively priced stereo tuner/amplifier
is quite outstanding.

Price: \$169



THE NEW COMPAX 2 SPEED TURNTABLE, \$39.50

Speeds: 33-1/3 and 45 r.p.m.

Method of drive: Belt driven around the platter perimeter.

Turntable material: Non-ferrous metal.

Diameter of platter: 12".

Height required below motor board: $\frac{3}{4}$ ".

Wow and flutter: 0.04 %.

Turntable mat: Anti-static material (not an extra).

Motor: Completely sealed 12 pole synchronous type.

Speed change mechanism: Unique system (pat. applied for).

Number of moving parts: 3 (rotor, platter and drive belt).

Ratio of mass: Turntable mass and drive mass are almost
identical.

Price: \$39.50.

Write for complete details to the Australian Distributors.

Trade enquiries to:—

INTERNATIONAL DYNAMICS (AGENCIES) PTY. LTD.

361 Bridge Rd., Richmond, 3121, Vic. Tel. 42 4403

AMATEUR BAND NEWS AND NOTES

Amateur TV in the United Kingdom

As it was the United Kingdom which first introduced television as a full-time public service, it is perhaps fitting that amateurs in that country should be well to the fore in amateur television. By contrast, the Australian amateur seems to show little interest in this sphere of activities.

By Pierce Healy, VK2APQ*

Apart from a small group in South Australia, there appears to be little amateur TV activity in Australia, although interest in VHF/UHF techniques is of a high order. This has been attributed to several factors, the major problem being stated as the high cost of equipment compared with the European market. Another factor stated is — climatic conditions in Australia allow field activities all the year round, thereby reducing time spent on constructional projects in the workshop.

In England, the British Amateur Television Club is a very active body with associate members throughout the world. It is not uncommon for "Video QSO's" to be made between members, such as that recently recorded in the R.S.G.B. magazine "Radio Communication."

"From G6KKD/T comes a reminiscence about the opening of last November and how it profited some of the television men as well as the UHF phone operators. Hearing a Video QSO in progress between G6NOX/T of Essex and G6ILD/T of Durham, he popped his TV transmitter on for a second as G6NOX/T went over.

"This action elicited an amazed comment from G6ILD/T to whom one picture had suddenly become another. A three-way television QSO followed over path distances well in excess of 150 miles.

"Some days later, after a committee meeting of the B.A.T.C. had drawn to a conclusion, it was decided to relax and enjoy a little television laid on by the Fenland net: First of all G6KKD/T engaged G6RIZ/T about 12 miles north of Ely in a video two-way contact, the latter putting on what amounted to a studio production, with simultaneous sound and on the vision side the benefit of a 3in image orthicon camera and two vidicons.

"G6KKD/T then locked in with G6PGF/T about 12 miles to the south, from whom, via a home built 8mM television, a number of films of amateur radio activity were received.

"None of those concerned would claim anything special about these contacts, but it is well worth recording as showing the highly developed state of the amateur television art which has been achieved in that corner of East Anglia."

UHF Achievement

Amateur station signals have now spanned the English Channel on the 2300MHz-2450MHz band. On February 18, 1968, what is believed to be the first contact between England and France was made by Dain Evans, G3RPE/P from the cliffs at Dover with Claude Paillard, F2FO/P near Calais. The optical path was about 35KM.

Two transmitters were used by G3RPE/P. One had a DET22 self-excited oscillator with transistorised modulator. An input of 8 watts gave 300mW output, A3 mode, at 2320MHz. The second used a self-excited oscillator-amplifier, using experimental transistors, constructed by Peter Tunbridge. The output was chopped 1KHz, the input was 2.5 watts and the mean power output 400mW. A feature of this transmitter was its stability. It could be held on a narrow band receiver (4KHz) while being keyed.

The receiver was a crystal controlled converter 2350MHz to 2352MHz followed by a narrow band (4KHz) transistorised tunable IF strip. The aerial was a 4-foot dish eight feet above ground and the site 350 feet above sea level.

At Cap Blanc Nez, west of Calais, F2FO/P equipment consisted of a 2C39 transmitter, pulse modulated at 200Hz, delivering 1kW peak output on 2350MHz, a broadband receiver, and a one-foot dish antenna. The location was 400 feet above sea level.

Beginner's Licence

The Postmaster General of the United Kingdom has advised the Radio Society of Great Britain that he has decided to introduce a Beginner's Licence to encourage people not yet possessing the qualifications for a full amateur licence. Details are being worked out and the licence is expected to be on issue later this year.

This statement is a complete surprise to the society, as it had previously advised the G.P.O. that it could not support a novice licence, having in mind the regulations for this type of licence in the U.S.A. However, the G.P.O. has stated that as soon as the details are worked out they will be available for discussion between G.P.O. and the R.S.G.B. representatives.

International Amateur Radio Union

The next Region I conference will be held at the Hotel Metropole in Brussels in May, 1969. It is the procedure for proposals submitted by member societies to be considered by one of three committees, and later brought to the full Plenary meeting. There are now 28 member societies in the Region I Division.

New Members

The national societies of Bulgaria and the Ivory Coast were recently elected to membership of the International Amateur Radio Union.

Reciprocal Licensing

A reciprocal licensing agreement has been concluded between France and United Kingdom. There is no charge for the licence. French licence conditions apply and mobile operation is permitted. The French National Society is responsible for the conclusion of the agreement.

Awards

Details of the following awards may be of assistance to those DX operators who follow that aspect of amateur radio activity.

The Auckland Award: Is issued to those operators who have worked 15 stations in the ZL1 call area, who are members of the New Zealand Amateur Radio Transmitter Branch 02 (Auckland) since World War II.

Mark Churton ZL1TB, 15 Grassways Avenue, Pakuranga, New Zealand is the custodian. There is no charge for the award, and all that is necessary is a certified list of the QSL cards held.

WIRELESS INSTITUTE OF AUSTRALIA VICTORIAN DIVISION A.O.C.P. CLASS

commences

MONDAY, AUG. 19, 1968.

Theory is held on Monday evenings, and Morse and Regulations on Thursday evenings from 8 to 10 p.m. Persons desirous of being enrolled should communicate with—

SECRETARY W.I.A.,
VICTORIAN DIVISION,
P.O. Box 36,
EAST MELBOURNE, 3002,
(phone: 41-3535, 10 a.m. to 3 p.m.),
or the Class Manager on either of
the above evenings.

CALLING ALL PROSPECTIVE AMATEURS

The Wireless Institute of Australia was established in 1922 to further the interest of Amateur Radio. With over 45 years experience, who could be more experienced in the teaching of this subject?

We are a non-profit making Organisation. Correspondence Courses are available at any time. Personal Classes commence in February of each year.

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* News and notes of Divisional and Club activities submitted for inclusion in these columns should be forwarded direct to Pierce Healy, 69 Taylor St., Bankstown, N.S.W., 2200.

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30,000 Ohms per Volt D.C.
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1 p.c. Multipliers and Shunts
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Printed circuit.
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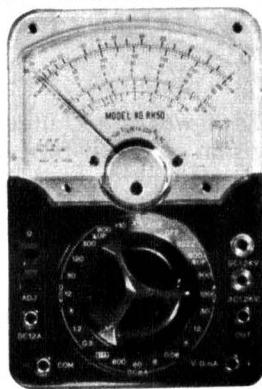
DC Voltages: 0-0.3-1.2-3-12-
30-120-300-600-1,200 V at
30,000 Ohms per volt.
AC Voltages: 0-3-12-30-120-
300-600-1,200 V at 13,000
Ohms per volt.

DC Current: 0.06-6-60-600
mA, 0-12 A.

Resistance: 0-60K-6M-60M
(350, 35K, 350K at mid-
scale).

Decibels: Minus 20 to plus 57
dB (0 dB equals 1 mW, 600
Ohms).

Audio Out: Capacitor in series
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Short Test: Internal buzzer.



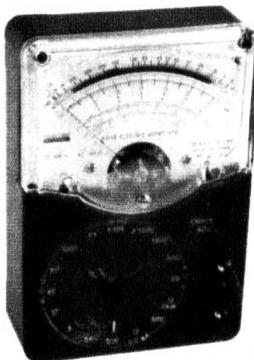
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Accessory: 1 pr. heavy test
leads.

Batteries: 1 (1.5V), 1 (1.5V).
Size: 3 5-16" x 6 5-16" x
2 1-16".
Weight: 1.4lb approx.

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Volt, Ohm, Milliamp Meters,
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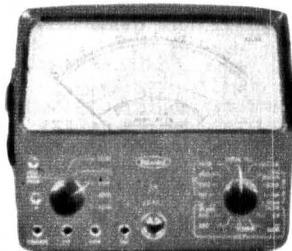
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With Test Leads and
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30,000 o.p.v.
5,000 and 25,000 V at
10,000 o.p.v.

AC Voltage: 0-2.5, 10, 50,
250, 500, 1,000 V at
10,000 o.p.v.

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DC Current: 0-50 uA, 1,
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AC Current: 0-1, and 10
amps.

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at 2,000 Ohms V.
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Ohms V.
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Resistance: 0-10K-1Meg; 60 ohms, 6K ohms
at centre scale.
Capacitance: 25uF to 1uF, in two ranges.
Decibels: 20 to plus 36db, two ranges,
Output: 0-100 V in four ranges.
Size: 5in x 3½in x 1½in.
Weight: 13oz approx.
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Helvetia Award: A very attractive certificate, known as the Helvetia 22 Award will be awarded to those who provide evidence, in the form of QSL cards and a check list, of having contacted all 22 Swiss Cantons since April 15, 1948. Contacts on any mode are eligible.

Return postage for cards should be sent with the application to: Henri Bulliard, HB9RK, P.O. Box 384, 1701 Fribourg, Switzerland.

SPPA Award: The Polish Amateur Radio Society (PKZ), issues the SPPA Award to licensed amateurs and short-wave listeners who can supply proof of contact or verification of reports with at least 100 different Powiat (districts), since January 1, 1946, QSOs with club stations — three letter call signs starting with K, P, or Z — are not eligible for inclusion.

Applications should consist of a check list of QSOs in alphabetical order of Powiat's abbreviations. QSL cards may be checked by the awards manager of a national society, and the certified list sent to: PKZ Awards Manager, P.O. Box 320, Warszawa 1, Poland, together with seven IRCs.

Gateway to Africa Award: This is an attractive certificate issued by the South African Certificate Hunter's Club, Chapter No. 3, to amateurs and listeners throughout the world for contacts with "ZS" members of "CHC." There are no date limits and all post war QSOs may be counted.

Stations outside South Africa need to have 25 points for contacts with at least three different ZS call areas. For the purposes of the award, contacts with ZS1AB and ZS3AB count 10 points, with charter members 5 points and other members 3 points.

Charter members are ZS1ACD; ZS1CY; ZS2MH; ZS3AH; ZS5OA; ZS5OB; ZS6ACD; ZS6IW; ZS6YB. Other members are: ZS1NQ; ZS1OU; ZS1RM; ZS2FA; ZS3D; ZS4IO; ZS4JB; ZS4MG; ZS5BP; ZS6ATA; ZS6BDU; ZS6BEJ; ZS6IX; ZS6TD.

A list showing call signs, frequency, date and mode of contact, together with points claimed should be sent to ZS1ACD, Max Adler, Box 1167, Capetown, Republic of South Africa. This award is free to physically handicapped or blind applicants, otherwise enclose a 75-cent (Aust.) postal order.

Duty Concession

At a conference in Niamey in November, 1967, the 14 members of the Union Africaine et Malagache des Postes et Télécommunications (the former French Territories in Africa) passed a recommendation to give duty free entry to radio equipment destined for amateur radio stations in their countries.

This is an important concession and could prove to be most valuable in developing amateur radio in the newly independent countries of Africa.

576MHz Record

A new 576MHz record has been set in South Australia. In the West Australian VHF Group News Bulletin the following details were given.

On Saturday, April 13, the record of 145 miles for a 576MHz two-way contact, held by VK5QZ and VK5ZJL, was broken. Contact was established over 184 miles between Port Augusta and Eden Hills, a suburb of Adelaide.

The operators were Charles Kosina, VK5KW/P and Rod Graham, VK5ZSD. Using 144MHz for the initial contact at 1815CST, signals were about R5 and S3 with some QSB. On changing to 576MHz signals were surprisingly stronger, S5 each way, remaining steady until the contact was concluded at 1835CST.

Equipment used:

In Adelaide: VK5ZSD:

Transmitter: QQEO3/20 straight final amplifier on 576MHz with an input of 25 watts, output of 8 watts.

Receiver: A TIS88 (FET) preamplifier, followed by two EC88 RF amplifiers, a 6CW4 nuvistor mixer, into a SE700B receiver.

Antenna: Four 15 element Yagis, 30 feet high.

In Port Augusta, VK5KW/P:

Transmitter: QQEO3/20 tripler with an input of 20 watts, output of 4 watts.

Receiver: TIS88 (FET) preamplifier, 7077 RF amplifier, 1N21 mixer, into a CR150 receiver.

Antenna: a 16 element screened beam, 15 feet high.

The path between the two stations was nowhere near line of sight. The heights of the stations were, in Adelaide, 700 feet above sea level and, at Port Augusta, 70 feet above sea level. However, a considerable portion of the distance was over

water and the remainder over fairly flat country. Both operators are confident that the equipment is capable of operating over distances exceeding 200 miles.

Credit is given by both operators to the FET preamplifiers used, being a fairly recent type of N channel junction FET operating in grounded gate configuration. At 576MHz a gain of 10dB with a noise figure of 4dB was obtained. Similar performance can be expected on 432MHz.

VK0AL has been reported with a good signal operating single-sideband on 14MHz. He is located on the Amery Ice Shelf, 70 degrees south, 70 degrees east. He is located in I.T.U. Zone 69 for those working for the P-75-P award.

WIRELESS INSTITUTE ACTIVITIES

The main task arising from the W.I.A. Federal Convention was the formulation of a draft constitution for the Region III organisation.

This is being handled by the Region III secretariat, provided by the W.I.A. The first draft has been prepared and following discussions will be circularised to member societies for their views.

The minutes of the 1968 Federal Convention have been printed and circulated to Divisions. As this document records the W.I.A. approach to the Region III organisation, it is sure to become a historic document on amateur radio in Australia.

NEW SOUTH WALES

Rising costs are being carefully considered by the New South Wales Division Council. At present members enjoy the lowest membership fee of any W.I.A. division. However, to maintain members' services and facilities, several proposals are being reviewed. In an endeavour to in-

crease membership, June was titled "Membership Month." From reports, results are very pleasing.

With the approach of spring, Divisional conventions are being prepared. The first two set down are:

The South West Zone Convention at Griffith over the October holiday weekend. Details in next month's notes.

The Blue Mountains Branch Field Day set down for Sunday, November 17. Details later.

An invitation to all amateurs and their families is extended by the organisers of the events.

ILLAWARRA BRANCH

Members of the Illawarra Branch of the New South Wales Division will be participating in the Models and Hobbies Exhibition to be held in the Wollongong Police Citizens Boys Club, Exeter Avenue, Wol-



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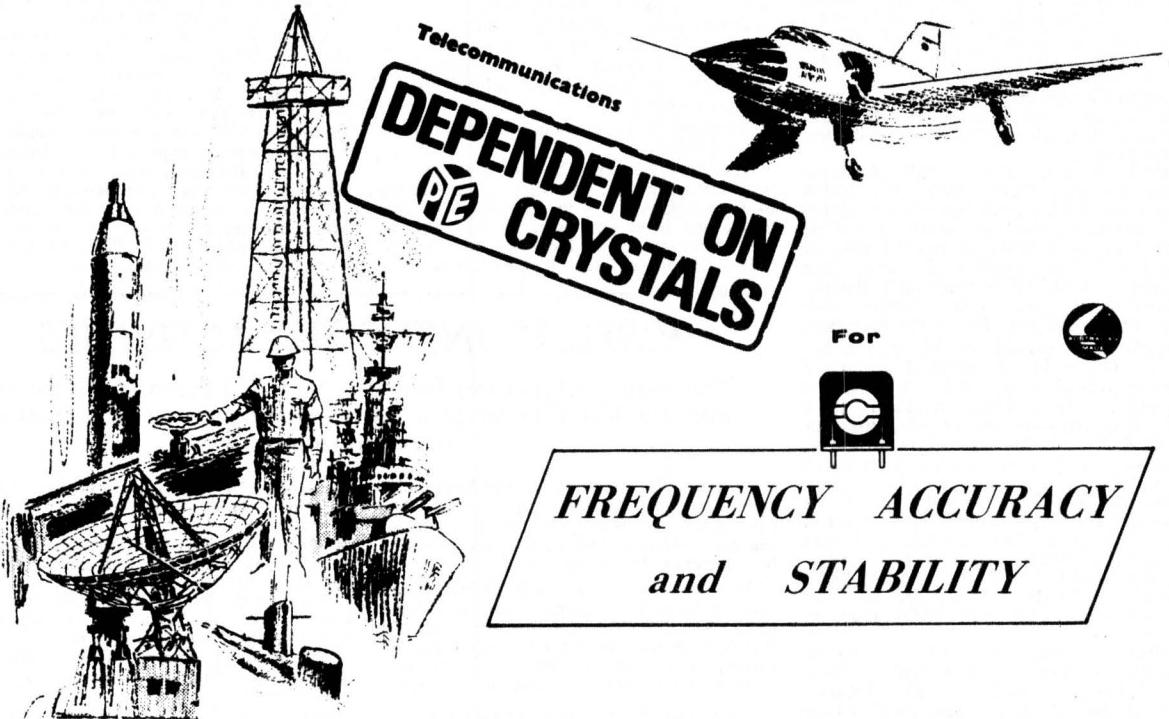
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- The arm itself is made of a light alloy H beam which eliminates the resonant frequencies of tubes.

UNIT 1: ERA Mk3, world's most brilliantly designed turntable, specifications and description above; Empire 888E cartridge frequency response from 10-30,000 cycles; Armstrong 421 fully transistorised stereo amplifier frequency response from 20-20,000 cycles plus/minus 1 dB less than $\frac{1}{2}$ per cent distortion on 15-watt RMS per channel; 2 Jordan Watts loudspeakers frequency range, on axis: 30-17,000 Hz plus/minus 3dB, 25-20,000 Hz plus/minus 6 dB, frequency range 30 deg. off axis: 30-17,000 Hz plus/minus 6 dB. **\$476**

UNIT 2: Schaub-Lorenz Model 4000 beautifully designed stereo tuner/amplifier, short-wave, AM/FM, built-in 18-watt output per channel, separate treble and bass controls, complete with Empire Model 2000 loudspeakers, frequency response from 30-18,000 cycles, power handling 60-watt; P.E. 34 turntable hydraulic-controlled lowering device, 4-speed, made in Germany; Empire 808E cartridge frequency response from 10-25,000 cycles. Total Price: **\$860**

UNIT 3: Pioneer 151 AM FM tuner 11-watt per channel; Dual 1010 turntable with B. & O. diamond magnetic cartridge; 2 R. & A. 10in loudspeakers. **\$270**

UNIT 4: Sansui 220 stereo tuner/amplifier shortwave broadcast, complete with 2 Goodmans 10in Twin-axle speakers. **\$210**

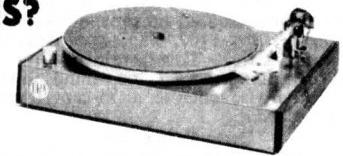
UNIT 5: Pioneer SMB300 tuner/amplifier 20 watt per channel magnetic input; 2 R. & A. 8in loudspeakers. Frequency response from 40-16,000 cycles. **\$200**

UNIT 10: Ampex Model 753, world's best professional tape recorder for domestic use, heads guaranteed for 3 years, unconditional guarantee for 12 months, sound on sound, tape monitor, echo chamber, sound with sound. Exclusive price **\$400**

UNIT 6: Dual 1019 Hi-Fi turntable complete with Empire 808 cartridge frequency response from 10-20,000 cycles. Plus Armstrong 221 and 2 R. & A. 10in loudspeakers. Add **\$190** Total Price of Unit **\$330**

UNIT 8: Harman Kardon Nocturne Model 210 tuner/amplifier, Empire 888TE cartridge frequency response from 6-32,000 cycles; ERA Mk3, world's most brilliantly designed belt-driven turntable and arm; Empire 2000 speaker systems. Total Price **\$1100**

UNIT 9: Armstrong 226 tuner/amplifier 10-watt per channel frequency response from 30-20,000 cycles plus/minus 1 dB, less than $\frac{1}{2}$ per cent distortion measured at 8-watt RMS per channel; 2 Schaub Lorenz Twin speaker systems, complete in beautifully designed cabinets, walnut or teak, approximate size 24 x 24 x 4in. fully imported from Germany; ERA Mk4 Hi-Fi turntable belt-driven; Empire 888PE cartridge, frequency response from 12-28,000 cycles. **\$440**



UNIT 7: Armstrong 222 integrated stereo amplifier, 10-watt RMS per channel frequency response from 30-20,000 cycles plus/minus 1 dB, less than $\frac{1}{2}$ per cent distortion measured at 8-watt RMS per channel; 2 Goodmans Twinaxiom loudspeakers, complete with Schaub-Lorenz Tourocord, definitely the best cassette player on the world market; 12-volt DC operation plays with full frequency anywhere, anytime. Very Special Offer **\$218**

UNIT 11: Schaub-Lorenz Intercontinental all-purpose receiver with 8 transistors, 15 semi-conductor diodes, 1 volume, 3 tuned circuits, 11 AM and 15 FM with built-in mains adapter unit, however it can also operate from an AC outlet, can be plugged-in to a worldwide reception unit, quality of sound equal to radiograms. Total Price **\$400**

UNIT 12: Armstrong 426 transistorised tuner/amplifier frequency response from 20-20,000 cycles, less than $\frac{1}{2}$ per cent distortion measured at 15-watt RMS per channel, plus minus 1 dB, England's best amplifier for the most reasonable price in Australia. For further details, write to Recorded Music Salon.

UNIT 13: You can hear your favourite music played when driving in your car. The Schaub-Lorenz Tourocord cassette player can be plugged through your Hi-Fi at home or through a portable radio. The sound reproduction equals that of the best tape recorder available on the market. (Refer Page 119, May, 1968, issue of "Electronics Australia".)

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WHOLESALE AND TRADE ENQUIRIES WELCOME

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longong, on August 24 and 25, 1968. It is anticipated that more than 20 organisations will be exhibiting, covering a wide range of hobbies and pastimes. Proceeds will aid the Wollongong Police Boys' Club.

The exhibition will be open from 10 a.m. to 9 p.m., Saturday, August 24, and 10 a.m. to 6 p.m., Sunday, August 25.

The branch intends to provide displays and demonstrate amateur equipment and to operate amateur stations on the HF and VHF bands. By contacting mobile stations during a hidden transmitter hunt, it is hoped to add a degree of interest for visitors.

At an extraordinary general meeting held on May 13, 1968, the officers elected for the ensuing year were:—

President, Roger Evans VK2BRE;
Vice-President, Eric Fisher VK2DY;
Secretary-Treasurer, Allan Ward VK2VH;
Committee Members, Lyle Patison
VK2ALU, Michael Carratti VK2ZHQ,
Peter Fackender;

Auditor, Basil Dale VK2AW.

A invitation is extended to those interested in amateur radio to contact the Secretary, Illawarra Branch, N.S.W. Division, C/- Lot 30, New Mount Pleasant Road, Mount Pleasant, Balgownie, 2519, N.S.W.

Snowy Mountains Radio Club

A new club, known as the Khancoban Amateur Radio Club, has been formed in southern New South Wales on the western slopes of the Snowy Mountains.

At present the membership is eleven and the main activities are radio theory and Morse code practice classes to prepare members for their A.O.C.P.

Officers of the Club are:—

President: J. Winkle;
Secretary: D. Johnstone;
Purchasing Officer: G. Bruce;
Morse Code Instructor: H. Pearson;
Radio Theory Instructor: D. Johnstone.

Members welcome visits by mobile operators touring the area.

For further details write to the Secretary, C/- Snowy Mountains Authority Hostel, Khancoban, 2642, N.S.W.

YOUTH RADIO SCHEME

The interstate conference of supervisors of the Youth Radio Scheme was held at the beginning of June in Melbourne. A detailed report was not available when these notes were compiled but, from discussions with the New South Wales delegates, it is learned that a number of points were resolved and it is hoped that a more uniform organisation will result.

It was resolved that the scheme would be financially self-supporting, and not dependent on subsidies from W.I.A. funds. It was proposed that the scheme be known as the Youth Radio Club Scheme of Australia, with its own rules and constitution.

Maitland Radio Club

The enthusiasm of the committee and members of the Maitland Radio Club has resulted in excellent progress, and it is receiving the support of various sections of the community. Several public figures are taking an active interest.

The club has two patrons, the Hon. Allan Fairhall, M.P., Minister for Defence, well known as VK2KB, a Life Member of the Wireless Institute of Australia, and Dr R. H. K. McKerihan, of Maitland, who has helped the club to gain many objectives.

Alderman Unicomb of Maitland, chairman of the Shortland County Council, and Mr F. Hinks, District Radio Inspector in Newcastle, have accepted Honorary Membership of the club.

On May 24 a presentation evening was held in the new Country Women's Association Hall, East Maitland. Members, their families, friends and official guests made the total attendance nearly 100. Chairman for the evening was Keith Howard, VK2AKX, District co-ordinator

of the Y.R.S., Jim Webster, VK2ZCW, Federal co-ordinator of the Y.R.S. addressed the gathering on various aspects of Y.R.S. activities.

Several speakers made presentations of awards, certificates and incentive packets to members. Jack Flynn, secretary of the N.S.W. division of the Y.R.S., assisted by Jim Webster, presented technical books on behalf of the Overseas Telecommunication Commission, to four members who gained 95 per cent or more in the Elementary Certificate examination. Alderman N. Blake, representing the Mayor of Maitland, presented 11 members with their Junior Certificates, and Inspector A. M. Jones of the Maitland Police presented four members with their Elementary Certificates.

The major event of the evening was the presentation of the Institution of Radio and Electrical Engineers Pennant Award, for the most successful club of the year, to the club president, Kev. Watson, VK2ZKW, by Dr W. G. Kirchner.

Accepting the pennant on behalf of the club, Kev. Watson spoke of future plans for providing permanent accommodation for the club and stressed the need for more members in order to fully realise the club's aims.

Dr Kirchner is chairman of the Newcastle Branch of the I.R.E.E. and senior lecturer in Chemical Engineering and Industrial Chemistry at the Newcastle University. He is also an amateur operator, call sign VK2ZK.

The speeches emphasised the need for youth movements such as the Y.R.S., not only to give the younger members of the community something to do in their spare time, but also to train them in an expanding field which would lead to a successful career in electronics.

To illustrate the Club's achievements and the members' enthusiasm, a display of photographs and home made equipment was arranged. Rudy Meinsma, Vice-

president of the Club, proposed the vote of thanks to all speakers. The proceedings concluded with an enjoyable supper prepared by the recently formed Ladies' Committee.

Westlakes Radio Club

The Westlakes Radio Club has added another first to its record of successes. This is the award of Senior Radio Certificates to three of its members.

The Senior Radio Certificate, considered by many as being as difficult as the A.O.C.P., has been awarded to Jan Oosterveen, Ian Miller and David Fraser. All three have already passed the P.M.G. A.O.C.P. or A.O.L.C.P. and decided to take the Y.R.S. Senior examination to complete the series.

To be eligible for the Senior Certificate it is necessary to have held the Y.R.C.S. Elementary, Junior and Intermediate awards. As well as a difficult theory test, candidates must have completed a formidable practical program and have qualified in a Morse test, sending and receiving at ten words per minute. The written examination consists of two papers, each of one-and-a-half hours' duration.

As well as the successes in the Senior grade, four Elementary and three Junior Certificates were won by club members at the examinations held during May.

Elementary Certificates:

Kim Piper,
Shayne Bartlett,
Barry Baker,
Kevin Scully.

Junior Certificates:

Rene Miles,
Ross Craney.

Joe Waugh, VK2ZJO, is about to relinquish the limited call sign, having passed the Morse test at a recent P.M.G. examination.

SOUTH AUSTRALIA

The second State Convention of the
(Continued on Page 141)

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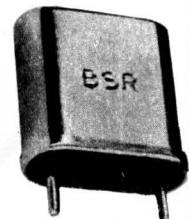
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The JAYEM 555 is an attractively-finished instrument which makes extensive use of semiconductors. It is compact (8" x 11 $\frac{1}{2}$ " x 17 $\frac{1}{2}$ "), lightweight (24 lbs.), and highly-reliable. The instrument is easy to operate and all controls have positive action. The instrument features a particularly good automatic triggering circuit with a stability of a very high order for easy lock-on to signals over the full frequency range of operation.

SPECIFICATIONS:

VERTICAL AXIS

Sensitivity: 0.02 V/cm-10 V/cm; 9 ranges: (\pm 3%).

Response: DC—7 MHz and 2 Hz—7 MHz, AC connected.

Rise Time: 50 Nano-seconds.

Input: 600 V max.; impedance: 1 Megohm parallel 33 pF.

Input Terminal: UHF receptacle (suits M-Type).

HORIZONTAL AXIS (Time Base)

Sweep Times: 1 μ Sec/cm-1 Sec/cm; 19 ranges (\pm 5%).

Expanded Sweep: 5 times (\pm 5%).

EXTERNAL SWEEP:

Expanded Sweep Sensitivity: 200 mVp-p/cm (\pm 5%).

Frequencies: 2 Hz-200 KHz.

Input Impedance: 1 Megohm parallel 40 pF.

SYNCHRONIZATION

System: Self excited trigger sweep.

Signal: Internal — External — Mains Frequency.

Trigger Range: Internal: 20 Hz-7MHz, 10 mm on CRT.

External: 20 Hz-7MHz, = 1 Vp-p.

CALIBRATOR

Output wave form: 1 KHz square wave.

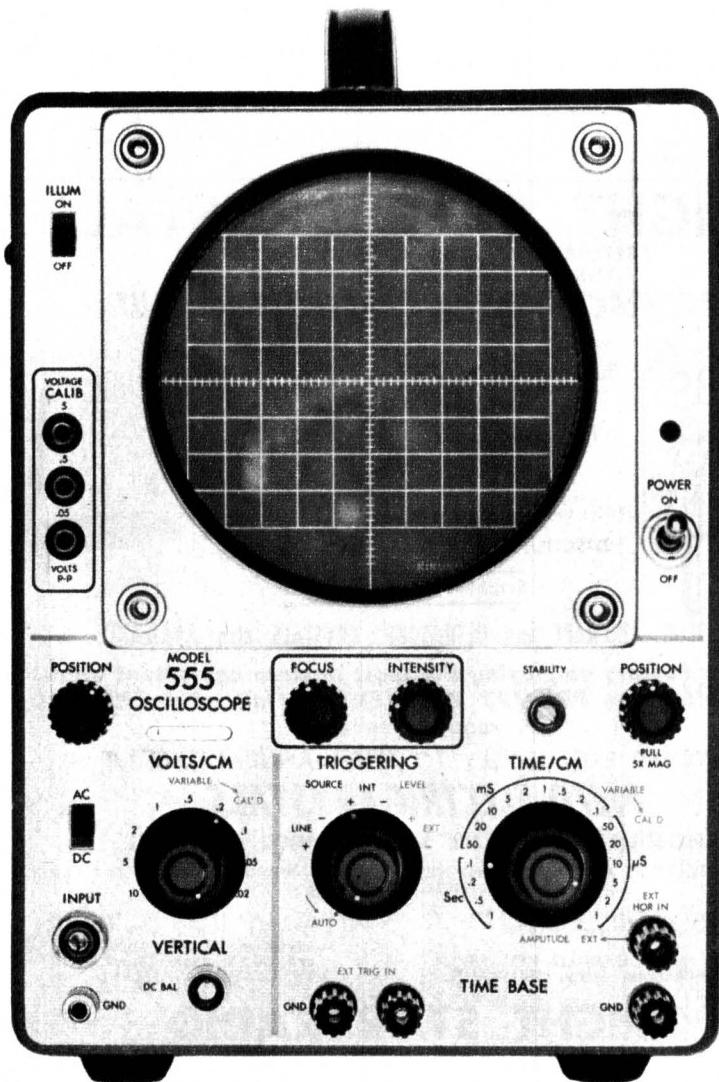
Voltage: 5, 0.5, 0.05 Vp-p (\pm 3%).

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MELBOURNE: 30 2491

ADELAIDE: 53 6117

BRISBANE: 2 6467

PERTH: 28 1102

LAUNCESTON,
TAS.: 2 5322



1968 REMEMBRANCE DAY CONTEST

A perpetual trophy is awarded annually for competition between divisions of Wireless Institute of Australia. On the trophy are inscribed the names of amateurs who made the supreme sacrifice in World War II. The Contest is conducted to perpetuate their memory throughout amateur radio in Australia.

Many who participate in this contest are not contest-minded in the true sense of competition but, rather, look upon the event as an opportunity to renew acquaintances with fellow operators throughout the Commonwealth. Nevertheless, to make the event successful it is necessary for logs to be submitted. In the past the percentage of logs received has been low when compared with the total who participate. The Federal Contest Committee of the W.I.A. and Divisional Councils invite all who are able to participate to do so, and submit a log of the contacts made.

Although awards are made to the highest scorers in each division, the contest is essentially between the six divisions of the W.I.A., the divisions being based on the State boundaries of the Commonwealth of Australia.

Discussions at the 1968 Federal Convention brought to light some anomalies in the scoring method for individual States. It was agreed that the formula used in 1967 did not resolve some undesirable aspects of the previous formula.

It was also considered impossible, under the present terms of reference, to arrive at an equitable and workable formula. It was therefore agreed that the rules of the 1968 contest be referred to as an interim measure, except that VHF participants be included in the 1967 rules. All divisions were requested to consider possible re-casting of the rules and to prepare submissions for the 1969 Federal Convention.

RULES

OBJECTS:

Amateur operators in each VK call area will endeavour to contact amateur stations in other VK call areas on any of the Australian amateur frequency bands. Intrastate contacts will be permitted on the VHF and UHF bands for scoring purposes.

CONTEST DATE:

0800 hours GMT Saturday, August 17, 1968, to 0759 hours GMT Sunday, August 18, 1968.

All amateur stations are requested to observe 15 minutes silence before the commencement of the contest on the Saturday afternoon. An appropriate broadcast will be relayed from all divisional stations during this period.

1. There shall be four sections to the Contest:

- (a) Transmitting phone.
- (b) Transmitting CW.
- (c) Transmitting open.
- (d) Receiving open.

2. All Australian amateurs may enter the contest whether their stations are fixed, portable or mobile. Members and non-members of the Wireless Institute of Australia will be eligible for awards.

3. All authorised amateur bands may be used and cross-mode operation is permitted. Cross-band operation is NOT permitted.

4. Amateurs may operate on both phone and CW during the contest, i.e. phone to phone, or CW to CW or phone to CW. However only one entry may be submitted for sections (a) to (c) in section 1 above.

An open log will be one in which points are claimed for both phone and CW transmission. Refer rule eleven concerning log entries.

5. For scoring, only one contact per station per band is allowed. However, a second scoring contact can be made on the same band using the alternative mode. Arranged schedules for contacts on the other bands are prohibited.

6. Multi-operator stations are not permitted. Although log keepers are permitted, only the licensed operator is allowed to make contact under his own call-sign. Should two or more wish to operate any particular station, each will be considered a contestant and must submit a separate log under his own call sign. Such contestants shall be referred to as "substitute operators," for the purposes of these rules and their operating procedure must be as follows:

Phone: Substitute operators will call "CQ RD" or "CQ Remembrance Day" followed by the call of the station they are operating; then the word "log" followed by their own call sign, e.g.,

"CQ Remembrance Day from VK4BBB, log VK4BAA".

CW: Substitute operators will call "CQ RD de" followed by the group call sign comprising the call of the station they are operating, an oblique stroke and their own call sign, e.g., "CQ RD de VK4BBB/VK4BAA".

Contestants receiving signals from a substitute operator will qualify for points by recording the call sign of the substitute operator only.

7. Entrants must operate within the terms of their licences.

8. Ciphers — Before points may be claimed for a contact, serial numbers must be exchanged and acknowledged. The serial number of five or six hours will be made up of the RS (telephone) or RST (CW) reports plus three figures, that will increase in value by one for each successive contact.

If any contestant reaches 999 he will start again with 001.

9. Entries must be set out as shown in the example, using ONLY ONE SIDE of the paper and wherever possible standard W.I.A. log sheets should be used. Entries must be clearly marked "Remembrance Day Contest 1968" and must be post-marked not later than September 9, 1968. Logs should be addressed to Federal Contest Manager, W.I.A., G.P.O., Box N1002 Perth, Western Australia, 6001. Late entries will be disqualified.

10. (a) Interstate scoring is as per published table for all bands: 52MHz and above included.

Declaration: I hereby certify that I have operated in accordance with the spirit and rules of the contest.

SIGNED

DATE

All contacts made during the contest must be shown on the log submitted (see Rule 4). If an invalid contact is made it must be shown but no score claimed.

Entrants in the Open Sections must show CW and phone contacts in numerical sequence.

12. The Federal Contest Manager has the right to disqualify any entrant who, during the contest, has not observed the regulations or who has consistently departed from the accepted code of operating ethics. The Federal Contest Manager also has the right to disallow any illegal, incomplete or incorrectly set-out logs.

13. The ruling of the Federal Contest Manager of the W.I.A. is final and no disputes will be discussed.

AWARDS:

Certificates will be awarded to the top scoring stations in sections (a) to (c) of rule 1 above, in each call area, and will include the top scorer in each section of each call area, operating exclusively on 52MHz and above. VK1, VK8, VK9 and VK0 will count as separate areas for awards. There will be no outright winner for Australia. Further certificates may be awarded at the discretion of the Federal Contest Manager.

The Division to which the trophy will be awarded shall be determined in the following way.

To the average of the top six logs shall be added a bonus arrived at by adding to this average the ratio of logs entered to the number of State licensees, (including limited licensees)

EXAMPLE OF TRANSMITTING LOG

DATE / TIME GMT	BAND	EMISSION AND POWER	CALL SIGN WORKED	RST No. SENT	RST No. REC'D	V.H.F. BONUS	POINTS CLAIMED

EXAMPLE OF RECEIVING LOG (VICTORIA S.W.L.)

DATE / TIME G.M.T.	BAND	EMISSION	CALL SIGN HEARD	RST No. SENT	STATION CALL	V.H.F. BONUS	POINTS CLAIMED
Aug. 1968							
18 0810	7MHz	A3(a)	VK5PS	58002	VK6RU	—	2
18 0812	7MHz	A3(a)	VK6RU	59007	VK7EJ	—	5
18 1035	52MHz	A3	VK4ZAZ	56010	VK5ZDR	25	28
18 1040	52MHz	A3	VK3ALZ	59025	VK3QV	—	1

(b) Interstate scoring for all bands above 52MHz will be on the basis of one point per contact.

See scoring table.

Note:—Read table from left to right for points for the various call areas.

In addition, all intrastate contacts on 52MHz and above are worth 1 point each.

Portable operation:—Log scores of operators working outside their own call area will be credited to that call area in which operation takes place, e.g., VK5ZP/2. This score counts towards New South Wales total points score.

11. All logs shall be set as in the example shown and, in addition, will carry a front sheet showing the following information:

NAME

ADDRESS

SECTION

CALL SIGN.....

CLAIMED SCORE.....

No. OF CONTACTS.....

multipplied by the total points from all entries in sections (a), (b) and (c) of Rule 1.

Average of top six logs plus:

Logs entered Total points from all entrants
State Licensees Sections (a), (b), (c)

VK1 scores will not be included with VK2 nor VK8 with VK5.

Acceptable logs for all stations shall show at least five valid contacts.

The trophy shall be forwarded to the winning Division and will be held by that Division for the specified period.

RECEIVING SECTION: Section (d):

1. This section is open to all short-wave listeners in Australia, but no active transmitting station may enter.

2. Contest times and logging of stations on each band are as for transmitting.

3. All logs shall be set out as shown in the example. The scoring table to be used in the same way as that used for transmitting entrants and points must be claimed on the basis of the State in which the receiving station is located. A sample is given to clarify the points score.

It is not sufficient to log a station calling "CQ" — the number he passes in the contact must be logged.

It is not permissible to log a station in the same call area as the receiving station on the bands between 1.8MHz-30MHz. But on bands 52MHz and above such stations may be logged, once only per band, for one point. See example given VK1/VK2 and VK5/VK8 are considered to be the same call area for scoring purposes.

4. A station heard may be logged once on phone and once on CW, for each band.

5. Club receiving stations may enter for the receiving section of the Contest, but will not be eligible for the single operators award. However, if sufficient entries are received a special award may be given to the top receiving station in Australia. All operators must sign the declaration.

AWARDS:

Certificates will be awarded to the highest scorers in each call area. Further certificates may be awarded at the discretion of the Federal Contest Manager.

SCORING TABLE

To	VKO	VK1-2	VK3	VK4	VK5-8	VK6	VK7	VK9
From VKO	-	6	6	6	6	6	6	6
" VK1-2	6	-	1	2	3	5	4	6
" VK3	6	1	-	3	2	5	4	6
" VK4	6	1	2	-	3	6	5	4
" VK5-8	6	1	1	3	-	5	4	6
" VK6	6	1	2	4	3	-	5	6
" VK7	6	2	1	4	3	5	-	6
" VK9	6	1	2	3	4	5	6	-

NOTE: Read table from left to right for points for the various call areas.

foster

hi-fi speakers

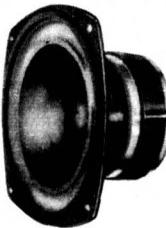
High Compliance tweeters

FT-502

SPECIFICATIONS
 Size : 50 mm (2 in.)
 *Impedance : 8 or 16 Ω
 Frequency Range : 2,000 ~ 20,000 c/s
 Sensitivity : 100 dB
 Power : 30 W max., 8 W nom.
 Dimensions : 82 x 82 mm, 29 mm depth
 Magnet Weight : 193 g (6.81 oz), Ceramic
 Weight : 615 g (1 1/8 lbs)

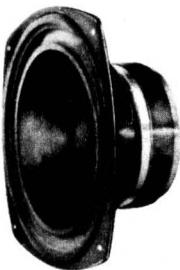
Price \$8.04.
Plus Sales Tax \$1.68.

High Compliance woofers

FW-162

SPECIFICATIONS
 Size : 160 mm (6 1/2 in.)
 *Impedance : 8 or 16 Ω
 Resonant Frequency (f_0) : 40 ~ 50 c/s
 Frequency Range : f_0 ~ 2,000 c/s
 Sensitivity : 97 dB
 Power : 30 W max., 10 W nom.
 Dimensions : 166 x 166 mm
 81.6 mm depth
 Magnet Weight : 500 g (1 1/8 lbs), Ceramic
 Weight : 1,660 g (3 1/16 lbs)

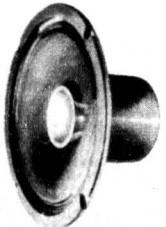
Price \$12.00.
Plus Sales Tax \$2.50.

FW-202

SPECIFICATIONS
 Size : 200 mm (8 in.)
 *Impedance : 8 or 16 Ω
 Resonant Frequency (f_0) : 30 ~ 40 c/s
 Frequency Range : f_0 ~ 2,000 c/s
 Sensitivity : 98 dB
 Power : 45 W max., 15 W nom.
 Dimensions : 208 x 208 mm
 90.8 mm depth
 Magnet Weight : 830 g (1 1/8 lbs), Ceramic
 Weight : 2,760 g (6 1/8 lbs)

Prices \$23.64.
Plus Sales Tax \$4.93.

Double-cone speakers

PW-65A

Size : 160 mm (6 1/2 in.)
 *Impedance : 8 Ω
 Resonant Frequency (f_0) : 70 ~ 100 c/s
 Frequency Range : f_0 ~ 15,000 c/s
 Sensitivity : 97 dB
 Power : 6 W max., 5 W nom.
 Dimensions : 164.9 φmm, 86.2 mm depth
 Magnet Weight : 77.6 g (2.73 oz)
 Weight : 476 g (1 1/8 lbs)

Price \$6.60.
Plus Sales Tax \$1.35.

*at 400 c/s; †at 3,000 c/s

High Compliance wide range speakers

FE-103

Price \$8.64.
Plus Sales Tax \$1.04.

FE-163

Price \$14.64.
Plus Sales Tax \$3.05.

Size : 160 mm (6 1/2 in.)

*Impedance : 8 or 16 Ω

Resonant Frequency (f_0) : 40 ~ 60 c/s

Frequency Range : f_0 ~ 20,000 c/s

Sensitivity : 98 dB

Power : 10 W max., 5 W nom.

Dimensions : 166 x 166 mm, 73.7 mm depth

Magnet Weight : 398 g (14.04 oz), Ceramic

Weight : 1,260 g (2 1/4 lbs)

Coaxial speakers

FX-201

with horn tweeter

Prices \$23.88.

Size : 200 mm (8 in.)
 *Impedance : 16 Ω
 Resonant Frequency (f_0) : 45 ~ 75 c/s
 Frequency Range : f_0 ~ 18,000 c/s
 Sensitivity : 101 dB
 Power : 10 W max., 5 W nom.
 Dimensions : 206 φmm, 137.5 mm depth
 Magnet Weight : 240 g (8.46 oz)
 Weight : 2,200 g (4 7/8 lbs)

2-way network



LC-100
Price \$6.60.
Plus Sales Tax \$1.38.

Crossover Freq.: 2,500 or 3,500 c/s
 Impedance : 16 Ω
 Attenuation : 6 dB/oct.
 Dimensions : 63.1 φmm, 69 mm height
 Weight : 280 g (9.88 oz)



2 or 3-way network



Crossover Freq.: 350 or 700 c/s, 2,500 or 5,000 c/s
 Impedance : 8 or 16 Ω
 Attenuation : 6 dB/oct.
 Dimensions : 83 H x 200 W x 134 mm D
 Weight : 1,430 g (3 1/8 lbs)

Price \$22.20.
Plus Sales Tax \$4.63.

tweeter



FHT-1

Price \$11.04.
Plus Sales Tax \$2.30.

*Impedance : 16 Ω
 Frequency Range : 2,500 ~ 16,000 c/s
 Sensitivity : 100 dB
 Power : 10 W max., 5 W nom.
 Dimensions : 110 mm height, 95 mm depth
 Weight : 330 g (11.75 oz)

(SOLE AGENT)



ZEPHYR PRODUCTS PTY. LTD.

70 BATESFORD ROAD, CHADSTONE, VICTORIA

YL Operator in G-Land

This YL operator is Mrs Ruth Sinclair, of Clarendon Road North, St. Annes-on-Sea, Lancashire, England, better known to amateurs all over the world as G3TNN. One of Britain's few women radio amateurs, she makes regular contacts with Australian amateurs, and her achievements include working all States in the U.S.A. and all European countries; and contacts with Africa, Ascension Islands, Japan and Russia. As well as operating phone, she is a competent Morse operator (note the bug key).



AMATEUR BAND NOTES . . . continued from p. 137

Y.R.S. was held at Elizabeth, South Australia on June 10, 1968. The meeting was under the chairmanship of Bob Guthberlet, VK5OD, the State Supervisor, who reported on the national convention he had attended in Melbourne.

Clubs from the Adelaide metropolitan area and several country districts were represented and a full discussion on the points reported by the chairman took place.

Elementary Certificate examinations were held at the Elizabeth and Port Augusta centres at the end of May. The following students were successful.

Elizabeth Amateur Radio Club:
Honours:

John Ellershaw,
Jeffrey Loveday,
Paul Philbrook,
Robert Worthington.

Credit:

Michael Bloodworth,
Paul Clemence,
Clifford Merry,
Bruce Topperwein,

Pass:

Douglas Graham,
Alan Manley.

Port Augusta Youth Radio Club:

Credit:

Aloysius Kriek,
Rodney Tozer,

Pass:

Andrew Gehling,
Robert Hall,
Robert Kaletsch.

Credit for an outstanding achievement and fastest progress recorded by a Y.R.S. member in South Australia goes to Philip Parise of the Elizabeth Club. Following success in the Elementary Certificate examination, with Honours in July, 1967, and a Credit in the Junior Certificate in September, 1967, Philip has obtained the P.M.G. A.O.L.C.P.

Full details of the Youth Radio Scheme in South Australia may be obtained from Secretary, Allen Dunn, 18 McKinlay Street, Elizabeth Downs, 5113, S. Aust.

NEW FM DISCRIMINATOR

Users of converted FM mobile units, who may be servicing or modifying such equipment, usually like to consider whether there are more recently developed components available which may improve performance. A new monolithic discriminator, recently announced, may have an application in such instances.

Developed by Bell Telephone Laboratories, it is a single quartz plate carrying a simple pattern of electrodes. It is suit-

able for detection of narrow band frequency modulated radio signals—a function which previously required at least four separate electronic components. It can be used to detect voice, telemetry, and narrow band data transmission over FM systems.

The discriminators can be produced to operate at centre frequencies in the range 10 to 30MHz, with a passband ranging from 0.01 per cent to 0.02 per cent of the desired midband frequency.

It consists of an AT cut quartz plate $\frac{1}{4}$ inch long by $\frac{1}{8}$ inch wide and a triple resonator array fabricated by deposition of three gold electrodes on the two major

surfaces. Controlling the amount of gold deposited makes the centre region resonant at the desired centre frequency. The other two regions are adjusted to the proper frequency above and below the mid-frequency by the same method.

The report, which appeared in "International Electronics," suggests that similar devices for use as wideband discriminators could be fabricated using other crystal material.

A REMINDER

The VK-ZL-Oceania DX contest Phone—October 5 and 6.

CW—October 12 and 13.

Rules in next month's notes. □

For details and illustrated catalogue all about

CRYSLER SPEAKERS

(see Full Page Advertisement this issue Page 112.)

Contact

RADIO PARTS PTY. LTD.

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TRANSISTOR VHF CONVERTERS
Tunable 108-136Mhz Aircraft Band.
1F in Broadcast Band. Battery incl.
\$14 inc. tax.

CRYSTAL CALIBRATORS No. 10
2 Khz Dial Calibrations. Usable to
144 Mhz. Inbuilt 500 Khz Crystal for
checking (Xtal included). Used, but in
good condition.

\$10.50, plus \$1.50 freight.

LINEAR RF AMP No. 2
Employs 4-807s in Parallel. Inbuilt 12v
Genemotor. Ideal SSB Mobile Linear.
Price, complete with Ant Tuning Unit
and two spare 807s, **\$12**. Due to weight
(approx. 35lb), they will be sent freight
forward.

COMPUTER BOARDS
Contain approx. 12-0A85s, or equivalent.
Diodes 2-12AT7s. Misc. components.
\$1 each.

VALVES
6J6 30c ea., 815 70c ea., 807 70c ea.,
6AC7 20c ea. or 12 for \$2, 6J7 40c
ea., 6C4 50c ea., 1K7 20c ea.,
QS150/15 50c ea., VR150/30 75c ea.
or 3 for \$2, VR105/30 75c ea. or
3 for \$2, 6AM6 50c ea., QB2/250
Philips (813). New in sealed cartons.
Current manufacture, **\$7 ea.**

PERSPEX OPTICAL QUALITY
New shipment arrived. 16 x 4 x 1/8.
30c per sheet.

**STAR ST700 SSB AMATEUR BAND
TRANSMITTER**

3.4-29.7 Mhz in 7 Bands. 455 Khz
Mechanical Filter for SSB. 250W PEP,
VOX, PTT, ALC. Internal Sidetone
Osc. for CW. 30 Khz per turn Tuning
Rate. Selectable USB/LSB. Break in
Keying for CW (no relay chatter or
clipped CW). SR 700A and ST 700
Combine for Transceive Operation while
still maintaining separate Trans-Rec
Facilities. ST700—\$519.50.

**STAR 700A SSB AMATEUR BAND
RECEIVER**

3.4-29.7 Mhz in 7 Bands. Triple Con-
version. Xtal Locked 1st and 3rd Oscil-
lators. Selectable USB/LSB. Variable
Threshold Noise Limiter. Selectivity
0.5, 1.2, 2.4, 4.0 Khz at 6db. 1 Khz
Direct Dial Read-out. Sensitivity 0.5 uV.
for 6dB/S/Noise on SSB. 30 Khz per
turn Tuning Rate. SR 700A—\$461.50.

MEASUREMENTS CORP.

MODEL 84 SIG. GEN. 300-1000 Mhz.
CW. Pulse or Sine Mod.
.1uV to 100mV
Modulation Sine: 400, 1000, 2500 Hz.
1.5-50 uS Pulse width.
.25-500 Pulse delay.
Price—\$375.00 Ex our Store.

WANTED BUY:
RECEIVERS, TRANSMITTERS, TEST
EQUIPMENT.

NEW RANGE OF RESISTORS, CONDENSERS AND POTENTIOMETERS

WE HAVE JUST PURCHASED THE COMPLETE STOCK OF RESISTORS, CONDENSERS AND POTS. OF A LARGE MANUFACTURER AND CAN OFFER SAME AT LESS THAN 25 PER CENT OF LIST PRICE.

The resistors are mainly I.R.C. and Morganite and are in a wide range of values from 200 ohm. to 3meg. in $\frac{1}{2}$, 1 & 2watt also included are I.R.C. 3watt wire wound 2,200 ohm. 3,300 ohm 4,700 ohm. etc.

List price \$9.00 per 100 our price \$2.00 per 100 post & packing 25c extra.

The condensers are in most popular makes and include Polyester, Paper, Mica, Ceramic & Electrolytic in standard values including 4mfd, 8mfd, 16mfd 300V etc.

List price \$11.00 per 100 our price \$2.00 per 100 post & packing 30c extra.

The potentiometers are all current types and include switch pots, dual concentric, 1meg. tandem, $\frac{1}{2}$ meg switch, tab pots etc.

List price \$12.00 per dozen our price \$2.50 per dozen post & packing 30c extra.

FREE With each lot of resistors, condensers or pots, we will supply free one new valve type 6U7G, 6X5GT, 1T4, 6K7G, or 12AT7. Resistors, condensers and pots are in packs of 100 or 12 and we regret we cannot supply to individual Lists of values or types.

New Hi-Fi Sound Recording Tapes. All Mylar Base.

3" x 150ft	60c
3" x 225ft	75c
2 $\frac{1}{2}$ " x 300ft	85c
3" x 300ft	85c
3 $\frac{1}{2}$ " x 600ft	1.75
5" x 600ft	1.50
5" x 900ft	2.00
7" x 1200ft	3.00
7" x 1800ft	3.75
Post and Packing, 25c extra.	

LEADER SIGNAL
GENERATOR LSG11
240V A.C. operated, 6 band
120KC to 390 Megs. Provision
for crystal. Post
N.S.W., 75c; Interstate, \$1.25.
\$34.00

USED HIGH-SPEED 240V. AC/DC MOTORS

These 240v. A.C. or D.C. motors are 1/8 H.P. with a speed of 7,000 R.P.M. and are ideal for small drills, grinders, etc. Dimensions, 5 $\frac{1}{2}$ in x 3 $\frac{1}{2}$ in. with 5/16in spindle \$3.75. Post, N.S.W., 50c; Interstate, 85c.

Switches for Hi-Fi Equipment Etc.



ROTARY SWITCHES and ROCKER SWITCHES

1 Bank 11 x 1 or 5 x 2, 69c
1 Bank 3 x 3 60c
2 Bank 5 x 2 \$1.20
Rocker Type D.P., D.T.,
50c.

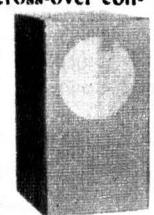
Post and Packaging
15c extra.

NEW BOOKSHELF SPEAKERS

Uses 6" Magnavox Dual
Cone Speaker plus 3TC.
Tweeter with cross-over con-
denser.
Dimensions
14" x 8" x 9"
deep.

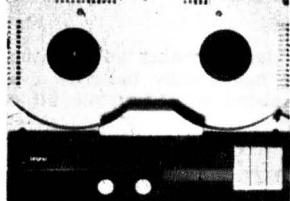
\$17.50

Post and Packing
Extra.
N.S.W. \$1.50.
Interstate \$2.00.



THE NEW COLLARO 3-SPEED 4 TRACK TAPE DECKS

\$55.00



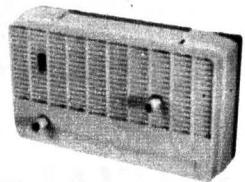
• 3-speed 1 $\frac{1}{2}$, 3 $\frac{1}{4}$, 7 $\frac{1}{2}$. • Pause control. • Takes 7in spools.

• Simplified controls, 4 Tracks, 555. OSC Coils, \$1.50.

The ideal deck for the home constructor, as amplifier and all controls can be mounted on deck.

NEW 4" EXTENSION SPEAKERS

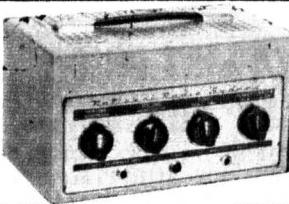
These 4" speakers are mounted in plastic cabinets suitable for use as intercom, units or extension speakers. Fitted with switch and volume control.
SPECIAL PURCHASE ENABLES
US TO SELL THESE UNITS AT
\$5.00. Post and Packing, N.S.W.
68c. Interstate, 98c.



A PREAMP FOR MAGNETIC PICK-UP OR TAPE HEADS

SUITABLE FOR USE WITH THE COLLARO OR B.S.R. TAPE DECKS

Using 3 silicon transistors as featured in October Electronics Australia complete with kit of parts including transistors mono \$7.50, stereo \$13.00, 240 power supply for above \$7.00.
Please specify if required for pick-up or tape heads.



NEW 17 & 25 WATT P.A. AMPLIFIERS

The 25 Watt Amplifier uses 5 valves plus 2 rectifiers including two EF86 low noise valves as microphone preamplifier and two EL34 valves Ferguson push-pull output.
All amplifiers are fitted with Ferguson output transformers with voice coil tappings of 2 to 15 ohms. The 25 watt amplifier can be supplied with line output transformers tapped from 100 to 600 ohms if required at \$2.00 extra.

Inputs provided for microphones, pick-up, and radio with mixing facilities and tone control.
The 15 watt is as above but using two 6BQ5 valves in push-pull output.

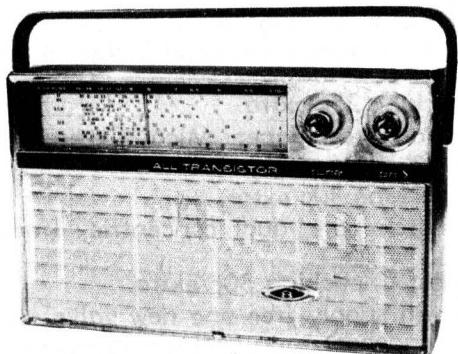
12in speaker for above (10 watt) \$7.75
Crystal Microphones for amplifier \$5.75

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NEW TRANSISTOR 8 KIT SET

SPECIAL PURCHASE ENABLES US TO OFFER THIS KIT SET AT \$24.00



DIMENSIONS

9" x 5" x 3" DEEP

(WIRED AND TESTED \$6.00 EXTRA)

- Complete kit of parts with circuit and full instructions
- Eight transistors.
- Magnavox 5X3 speaker gives excellent fidelity.
- High sensitivity, suitable for city or country use.
- Heavy duty battery for economical operation.
- Modern design, plastic cabinet with gold trim.
- Dial calibrated for all states.
- Available in colours of off-white, red, black or light green.

Post & Packing extra. N.S.W. \$1.25, interstate \$1.75.

NEW TRANSISTOR CAR RADIO

New transistor six car radios with R.F. stage, of Aust. manufacture using A.W.A. components and transistors.

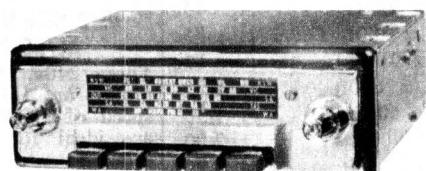
Available in manual or push-button models with dial calibrated for all Australian States.

Supplied with speaker (5", 6", 5 x 7" OR 6" x 9") and lock-down aerial.

MANUAL MODEL \$43.00

PUSH-BUTTON MODEL \$48.00

Post and Packing N.S.W. \$1.50, Interstate \$2.50.



Suitable for 6 or 12 volts for positive or negative earth. Please state type required.



\$23.75

NEW TRANSISTOR SIX PORTABLE KIT AT LESS THAN HALF PRICE

(DESIGNED TO SELL AT OVER \$60.00)

Excellent fidelity is obtained in this new kit set by the use of large speaker and polished timber case with attractive gold metal front panel. By using heavy duty batteries it is economical to operate and is ideal for portable use or that second set. Complete kit of parts is supplied with full instructions.

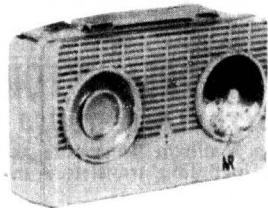
Post and packing N.S.W., \$1.25—Interstate, \$1.75.

SPECIAL—OFFER

Complete KIT for TRANSISTOR 6 PORTABLE \$17.50

The complete kit of parts for the transistor six includes six transistors, printed circuit board, coil kit, 4in speaker, Ferguson driver and output transformers, heavy duty battery and all necessary parts to complete the set with full instructions. Set is housed in attractive plastic case as illustrated.

Dials available for all States. Post and Pack: Extra. N.S.W., \$1.00. Inter., \$1.30.



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Ideal for the experimenter or service man.
Each package of 12 contains 3 of each of the following types.

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Equivalent:

OC45 R.F. Transistor.

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THESE TRANSISTORS
CAN BE SUBSTITUTED
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TYPES.

Post and Packaging 10c
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LISTENING AROUND THE WORLD

Art Cushen's monthly report on long-distance short-wave, television and broadcast band reception.

Radio Nepal Increases Power to 100KW

Most Australian and N.Z. listeners will soon be able to add a new country to their list when Radio Nepal, broadcasting from Kathmandu, commences transmissions with its new 100KW transmitter this month.

Broadcasting commenced in Nepal in 1953 with a low-power transmitter and several listeners have heard the transmissions. The new Radio Nepal is a gift from the British Government and includes high-powered medium and short-wave transmitters. At present, two 5KW transmitters on short-wave, and a low-powered medium-wave transmitter are operating from Kathmandu. In 1966 work began on the building of a new broadcasting centre at Kathmandu, with six studios and a transmitter building located some four miles from the centre of Kathmandu. This building houses the new 100KW short-wave and 10KW medium-wave transmitters. The aerial towers include a vertical mast of 300 feet, to be used by the 10KW medium-wave station on 790KHz.

Test transmissions on short-wave are expected to begin soon on 7165KHz, from 1400 to 1600GMT. Tests on medium-wave should begin at the same time. Four 100ft masts have been erected to support the short-wave aerials, which have been cut for operation on 60 and 41 metres for local coverage, and 31 and 25 metres for external broadcasting. The station is keen to learn of reception of the tests of Radio Nepal and the reports should be sent to Radio Nepal, Kathmandu, Nepal.

LATE NEWS

NEPAL: Radio Kathmandu has now been received with test transmissions on 9590KHz 1420-1720GMT.

SINGAPORE: Forces Broadcasting Service has moved from 5010 to 6040-KHz and has been heard on Sunday at 1000GMT with "B.B.C. Sports Round-up" and at 1015GMT with a B.B.C. program "Pick of the Pops."

QATAR: Radio Qatar at Doha is testing its new 100KW transmitter on 9570-KHz, 1300-1500GMT. Programs are also carried on 674KHz MW with 10KW.

CP75 MOVES TO 5025KHz

The well-known gospel station at La Paz, Bolivia, CP75, with the slogan "La Cruz de Sur" (Southern Cross Radio), moved to 5025KHz recently. The station made an initial test on this frequency on May 12 and has now decided to use this new outlet in place of 4985KHz. Tests had been carried out so that reports from listeners could be assessed as to the reception on the new frequency. These were transmitted around 0500GMT.

Listeners in Australia also report the signals at 0955GMT and Robert Shepard, at Glen Iris, Victoria, reports the sign-on at good level. The station opens with an anthem, followed by announcements. At 1000GMT there is a religious program, usually in Spanish. Radio La Cruz del Sur was initially heard some years ago in this area when using 9505-

KHz and the call sign CP38, with similar type of programs, around 1000GMT.

RADIO RELOJ, BOGOTA

The reception of a new Colombian station, Radio Reloj, Bogota, on 4790KHz, has been the major item of news from this area. The station is being received to sign off at 0700GMT and has an announcement after each recording of Latin American popular music, which includes the slogan and time. Each 15 minutes a recorded announcement is broadcast, which indicates the station has medium and short-wave transmitters and is a member of the CARACOL Network. Full postal address of the station is not known, but reports sent to the network should reach the station.

RADIO EMISORA, BOLIVIA

The numerous Bolivian signals reported in recent issues has indicated a greater activity in radio in that country which, for many years, was one of the hardest to receive from Latin America. Radio Emisora, Bolivia, is now being received on 4755KHz to sign off at 0600GMT, with good level, and also heard opening at 1000GMT. The station closes with the Mitch Miller version of "Colonel Bogey March." Recorded station announcements are frequent and indicate MW, SW and FM frequencies are used. The station is located at Oruro, Bolivia, and has the call sign CP62 assigned to 4755KHz.

RADIO NEDERLANDS EXPANSION

With the construction of the Bonaire relay station for Radio Nederlands now near completion, the station has announced plans for a high-powered relay base in Madagascar, to serve the Pacific, Asia and Africa area. The new transmitting site will be built at the cost of \$A24-million. The land has been purchased and early planning of the site is now under way.

The "Happy Station" program of Radio Nederlands, heard on Sunday with Edward Startz, is to celebrate its fortieth anniversary in November and is the longest-running short-wave program on the air. A special verification card is now being issued to celebrate this.

CP58 USING 6005KHz

A new signal from Bolivia is that of CP58, "Radio Progresso," which has been heard in New Zealand opening at 0900-GMT and closing at 0430GMT. From 0900 to 0930, the station has a program in a local Indian dialect, and from 0930 the program is in Spanish with frequent commercial announcements. The signal heard in N.Z. in the afternoon to sign off at 0430GMT suffers from interference, but the familiar "Radio Progresso" slogan is heard with an echo effect. Power of the transmitter is 10KW, and this is another Bolivian signal which should be widely heard.

CHANGES FROM BELGRADE

Radio Belgrade, Yugoslavia, has brought into service some new frequencies. The English program is now being received on additional frequencies, and this is also the case for some foreign language programs.

The changes in the English sessions are as follows:

GMT	KHz
1530-1600	9620, 11735, 15240
2200-2215	6100, 7200, 9620

In addition, programs in Arabic are carried at 1830GMT and Russian at 1700 and 1900GMT. Further English transmission at 1830 and 2000GMT are also on 6100, 7200, 9620KHz. The 2200-GMT bulletin is also carried on the medium-wave frequency of 1268KHz.

RADIO NEDERLANDS CHANGES

Radio Nederlands in Hilversum, Holland, has brought into service some new frequencies in the higher short-wave bands for our present winter period.

GMT	KHz
2230-2245	17750
2310-0005, 0100-0200	17750
1900-2005 (week days)	21540
2025-2150 (Sunday)	21540

The frequency of 21540KHz is also used for "Dutch by Radio" services at 1700-1720, 1930-1950, 2000-2020GMT on Sundays, and from 1900-1920GMT with Dutch and Spanish to the West Indies.

The transmissions from Radio Nederlands continue to be heard in English on

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No. 46 Heat Sorb Clamp

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- Charges 6V and 12V Batteries overnight.
- High 4-amp. charge rate
- 12 months written GUARANTEE.

Top quality! Top performance! A fantastic direct deal from top manufacturer. They are usually sold at \$30.00. Finest quality components; steel case. Charges 6v. and 12v. batteries from 240v. A.C. mains. Complete with fuse, ammeter, long lead with alligator clips for battery terminals and long flex with 3-pin plug. Units are brand new in carton and have passed strict electrical authorities test. Use also for electric fences and electric model trains.

(Pack, post \$1.25c)

Amazing Offer!

FAMOUS TAS

1 HP

PETROL

ENGINES

\$25.00

Made in Japan and brand new.
3 MONTHS WARRANTY

Pack, post 75c. A mighty little power plant made by the world famous TAS Motor Co., "TAS" precision-engineering has produced this powerful, compact unit unrivaled for long trouble-free service. Spare parts will always be available even in years to come. Specifications — • 2-stroke air-cooled by large fan. • bore and stroke 30x30 mm. • speed range 1,500-6,500 r.p.m. • max. power 1 h.p. at 6,500 r.p.m. • cylinder barrel-alloy with long life nickel chrome liner. • conrod bearings; large rollers in a precision-forged steel conrod. • main bearings — heavy duty ball bearings. • magneto—high intensity; tropic-proof, fly wheel type. • will run in any position. • complete with instruction book, parts list and set of tools.

Use for driving pumps, generators, go-karts, compressors, etc. A bargain never before offered in Australia. Rush your order now! with clutch \$1.95 extra.

1 h.p. motor, as above, with 3,300 r.p.m. reduction gear box 600-3,300 r.p.m. \$29.50. Also 2 h.p. TAS petrol engine available. \$33.00 (freight \$2.50).

Magnificent

"Cutler"

Hammer"

TOGGLE

SWITCHES

75c



(Post pack 10c.)

4-pole 3-way (3-position) panel switches (centre off). Made for U.S. Govt. at a cost of 35/- ea. Luminous tip on switch. Solid silver contacts. Size 1 1/2" x 1 1/2" x 2" high. Handles 10 amps. at 12 or 24/32 volts D.C. Ideal for panels, control boards, etc.

Amazing offer!

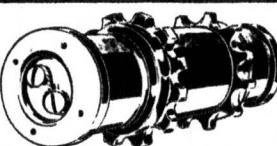


\$39.90

**1 h.p. Petrol Motor
& PUMP UNITS**

Freight \$3. Huge purchase allows this terrific offer. Unit comprises 1 h.p. TAS brand 2-stroke petrol motor, belt-driving an American 2,400 g.p.h. all-metal centrifugal pump. A precision-engineered motor with main bearings, heavy duty ball bearings; long life, nickel-chromed cylinder; precision forged steel con rod; magneto ignition; governed speed. This motor is unrivaled for long trouble-free service. Pump has 1" inlet, 3" outlet and is salt-water proof (will not rust or corrode). Whole unit is mounted on steel base and will pump to over 50ft. head. Supplied with instruction book, parts list and set of tools.

- ★ Full 3 MONTHS GUARANTEE
- ★ COMPLETELY PORTABLE
- ★ SPARE PARTS ALWAYS IN STOCK



**"HUGHES" AIRCRAFT
GEARED MOTOR \$5.50**

Pack 50c. A h.p. geared motor made by Hughes Aircraft Co., U.S.A. for feeding ammo. belts to gun turrets. Has 2 sprockets turning at approx. 100 R.P.M. "A little power baby" with many uses; including turntables, small winch, etc. For 24/32v. D.C. use (works perfectly on 12v.).

Money cheerfully refunded if not completely satisfied.

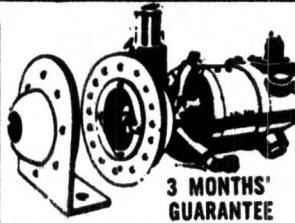


**Heavy duty 5,200 g.p.h
Centrifugal PUMPS**

(Pack, post \$1.)

\$12.50

A real scoop! Direct purchase and top quality. 1 1/2" inlet, 1" outlet, corrosion proof (salt water proof), all metal centrifugal pumps. Capacity up to 5,200 g.p.h., pressure up to 45 P.S.I. Heavy duty bearings gives pump smoother running and long life. Handles heaviest loads and highest speeds — designed to pass solids such as sand, silt, dirt, etc., without damage. Heads to 90ft., suction lift to 25ft. A bargain never before offered in Australia. Spare parts always available. Full 90-day guarantee. Same pumps as above, 1 1/2" inlet, 1" outlet, with less capacity 3,500 g.p.h. Heads to 60ft., suction lift 20ft. Has two bearings. \$11.95; pack, post \$1. Foot valve for 3" pipe \$1.55, for 1" \$1.85 (Post if separate 20c)



**3 MONTHS'
GUARANTEE**

**Exclusive Release . . .
FAMOUS AMERICAN
THOMPSON 1,000 G.P.H.
ELECTRIC PUMPS &
MOTOR \$15**

the world's most famous manufacturer of pumps. This is the second release of their pump and motor produced at a Govt. cost of \$100 each.

Pump and motor only, \$15.00. Housing, \$3.50; Foot Valve, \$1.55; Adjust. Rheostat, \$3.75. Pack, despatch and freight on pump and motor, only 50c.

• TERRIFIC BUY — U.S. Govt. cost \$100 ea. • AIRCRAFT

QUALITY — neoprene seal, fully ball bearing non-corrosive housing and impeller • CONTINUOUS

DUTY MOTOR — sealed, ball-bearing brush motor • PUMPS ALL

Liquids — water, kero, petrol, diesel, fuel, etc. (1" outlet pipe for hose). • LASTING QUALITY

— sealed unit, corrosion and explosion proof. Electric motor is for 24/32 volts AC/DC (perfect on 12 volt) and draws only 5 amps. Will shift 1,000 g.p.h. at 15 p.s.i., 800 g.p.h. at 6' head. On 24 volts pump will lift 40ft., less on 12 volts. If primed or with foot valve, will suck 20ft. then lift 20ft.; less on 12 volts.

Pump can be bolted to side of tank or drum or used with impeller housing with angle base which has threaded inlet for 1" waterpipe. Use pump as water pressure system for taps — have on/off switch (50c) near tap.

Adjust. rheostat 7" long accurately controls output of pump 0 to 1,000 g.p.h., \$3.75.

240 volt to 30 volt, 5 amps.

transformer to operate pumps on mains gives full output on

pumps, \$7.95 plus 75c freight.

Spare seal for motor 50c.

**4 Transistor, 3 Watt Output
AUDIO AMPLIFIERS \$7.95**

Fresh 1967 current production brand new in cartons. Specially designed to provide a complete and reliable basic unit for portable gramophones, radios, intercoms, tape recorders, P.A. systems, etc. Latest printed circuit design suitable for 3 to 15 ohm speakers. For use with 9v. transistor radio battery. Frequency response 150-10,000 c.s. A pair are ideal for stereo. Size only 3" x 2".

**Now 4 AMP 3-18 volt
SELENIUM RECTIFIERS**

Current English make. Brand new. Converts A.C. to D.C. \$1.50. Post 25c. 2 1/2 AMP. 85c (Post 15c).

English 240 volts to 14.5 volts 11 amps stepdown transformers. Made by "COSSOR". Weight 16 lbs. Rail freight collect. \$11

**HALF-PRICE SPECIAL
HI-FI RECORDING TAPE**

Fantastic purchase of "Mylar" professional recording, computer tape (the best money can buy). Famous 3-name brand (one we can't mention due to huge price reduction). Silicone lubrication. Suits all tape recorders, hi-fi and stereo. Selling well under half price. Post 10c each.

3" 225' **65c**

5" 600' **\$1.50**

7" 1200' **\$2.50**

Also long play 5 1/2" 900ft.—\$2.25. 7" 1800ft.—\$3.25.

Post 10c ea.

NIFE BATTERIES—95c

(Pack, despatch and post 10c ea.) Brand new! Nickel iron, spill-proof, leak-proof cells—

Lasts forever, 4 A.H. 1.2 volts. Sizes 3 1/2" x 2 1/2" x 1". Couple together for any voltage—superb for spotlights, lamps, bells, flash equipment, etc.

Set of 10 gives 12 volts 4 A.H. \$7.95 (Pack post \$1); Set of 5 for 6 volts, 3.95 (Pack post 50c).



Famous

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OHMS

MULTIMETERS

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Extremely sensitive 20,000 ohms complete with full instructions and probes. Post free.

RANGES:— D.C. VOLTAGE: 5.25-250-500-2.5K (20,000 ohms per volt). A.C. VOLTAGE: 10-50-100-500-1000 volts (10,000 ohms per volt).

D.C. CURRENT: 0-50 uA, 0-2.5 MA, 0-250 MA. RESISTANCE: 0-5K, 0-6Mg. (300 ohm scale and 30K at centre scale). CAPACITANCE: 10 uuf to .001 uF, .001 uF to 1uF. DECIBELS: -20 to +22DB

"Sperry" Transformers \$2.50

(Pack, post 75c.) Brand new! For radio use. Primary 0/200/210/

220/230/240/250 volts. Secondary 6.3 volts at 3 amps.; 6.3

volts at 3 amps. and 2 volts at 1 amp.

Famous E.M.I. TRANSFORMERS

\$6.50

Brand new! These were made for the British Admiralty, are tropicalized for indefinite storage. Primary 10 / 0 / 200 / 220 / 240. Secondary 300 / 0 / 300 volts at 150MA. 6.3v. at 3 amps. and 5v. at 3 amps. Govt. cost \$40.

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week days, 0730-0820GMT on 9525-9715 and 11730KHz.

RUSSIAN STATIONS

UKRAINE: Radio Kiev now broadcasts in English on Monday, Thursday and Saturday to North America at 0030GMT on 9500, 9610, 12000, 15270, 17720, 17750 and 17770KHz, and at 0430GMT on 11850, 11890, 15100 and 15390KHz. To West Europe on the same days in English at 1930GMT on 9560, 11710 and 11830-KHz and at 2230GMT on 1241KHz. Radio Kiev also broadcasts in German on Tuesdays and Fridays at 1930GMT on 9570, 11705 and 11830KHz, and at 2230-GMT on 1240 KHz.

ARMENIA: Radio Yerevan broadcasts to America via Radio Moscow Pacific Coast transmitters on Wednesdays, Thursdays, Saturdays and Sundays at 0300-0330GMT, with English at 0325 on 15140, 15180, 17790 and 17880KHz (the last-named being a new frequency). Radio Yerevan also broadcasts to Europe on Sunday at 0800-0900GMT on 1530KHz.

KAZAKH: Radio Alma-Ata can be heard in German every Tuesday and Thursday at 1130-1200GMT on 10530-KHz.

KGEI to 250KW

Radio KGEI, operated at San Francisco by the Far East Broadcasting Company, is testing a new 250KW transmitter for its Latin American beam. The station is keen to receive reports from listeners with a comparison with reception from the old 50KW transmitter.

Using the slogan, "The Voice of Friendship," and the mailing address, P.O. Box 15, San Francisco, California, the station has programs in English to Latin America at 2230-2300 and 2330-2400GMT on 15240KHz. Programs at 0330-0400GMT also in English. The remaining programs are in Spanish and Portuguese.

CLANDESTINE RADIO STATIONS

Two of the best-received transmissions from clandestine stations are now able to be verified. The most popular, Radio Independencia Espana, has the postal address of Box 359, Prague 1, Czechoslovakia. The station is frequently heard at 0600GMT, with programs for Spain, and 12140KHz is the best frequency.

The Polish Pathfinder station has the mailing address of Konopnickiej 6, Warsaw, Poland. The station confirms reception reports with a coloured card. The station operates weekdays, except Monday, 1100-1700GMT, and Sunday 0900-1700-GMT on 6850 and 7306KHz. The power is understood to be 300 watts and the programs are of light popular music.

ROMANIA TO PACIFIC

Radio Bucharest in Romania has commenced a daily transmission for reception in the Pacific area. The service is on the air at 0630-0700GMT and uses 17845-KHz. The station has introduced a DX Club program and has issued six new verification cards with different views of Romania. To Europe and North America, the DX program is broadcast on Wednesday and Friday at 1930 and 2230GMT, and Thursday and Saturday at 0130, 0300 and 0430GMT.

SWEDEN USES 15445KHz

Radio Sweden at Stockholm is using the new frequency of 15445KHz for its transmission in English to the Far East from 2245 to 2315GMT. The frequency provides good reception, but at 2315GMT, when the service is continued in Swedish, some sideband interference is suffered from Radio Berlin International using 15450KHz for a broadcast in Portuguese to South America. The transmissions in English from Radio Sweden to the Far East are as follows:

GMT	KHz
0830-0900	17800
1245-1345	15310
1600-1700	15310
2045-2115	11915
2245-2345	15445

NEW SCHEDULES OPERATING

BROADCASTS FROM MADRID

The External Service of the Spanish National radio is carried from Madrid and the relay station in the Canary Islands.

From Madrid

GMT	KHz	Area Served	Language
0000-0600	15420, 11710, 9570, 9360	Latin America	Spanish
1400-2300	9570, 7105, 6140	Europe	Spanish
0830-0900	15420	Africa	Spanish
1200-1230	15420		
1900-2345	9370		
2315-0115	9760, 6130	America	Spanish
0630-1130	9360	Far East	Spanish
1200-1700	9760		
1730-2230	9760		
0200-0445	6130, 9760	USA, Canada	English
1245-1345	6130	Morocco	French
2030-2130	6130		

From Canary Islands

2000-0400	15380, 11880	Latin America	Spanish
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The powers of the Madrid transmitters are 100, 50 and 20KW, and those at Tenerife, Canary Islands, are 100KW.

RADIO JAPAN DX SESSION

The Radio Japan session for the short wave listeners, from Tokyo, is heard on the third Saturday and following Sunday each month.

Saturday Broadcasts

GMT	KHz	Area Served
0825-0830	21535, 17825	Europe
1015-1020	15235, 11875	Australia, New Zealand
2055-2100	15235, 11965	Europe

Sunday Broadcasts

0020-0035	17825, 15135	North America East Coast
0235-0250	21640, 17825, 17725, 15235	North America West Coast

RADIO SWEDEN SERVICES

Radio Sweden, Stockholm, now has in operation some new frequencies and additional transmissions.

GMT	KHz	Area Served
0830-0900	17800	Far East
1230-1330	15310	
1600-1700	15310	
2015-2115	11915	
2245-2345	15445	
0445-0615	17845	South Asia
0830-0900	15240	
1400-1530	21585	
0930-1030	21690	Middle East
1830-1930	21690	
1130-1330	21675	Africa
1730-1930	15240	
0000-0230	11705	South America
2245-2345	11705	
0000-0230	15275	Eastern North America
1100-1215	15240	
1400-1530	17760	
0300-0430	11705	West North America
1600-1700	15315	
2130-2230	11705	South-West Europe
0630-0715	6065	Europe
0930-1215	9625	
1730-1800	6065	
1945-2115	6065	
2130-2230	6065	

BROADCASTS FROM ATHENS

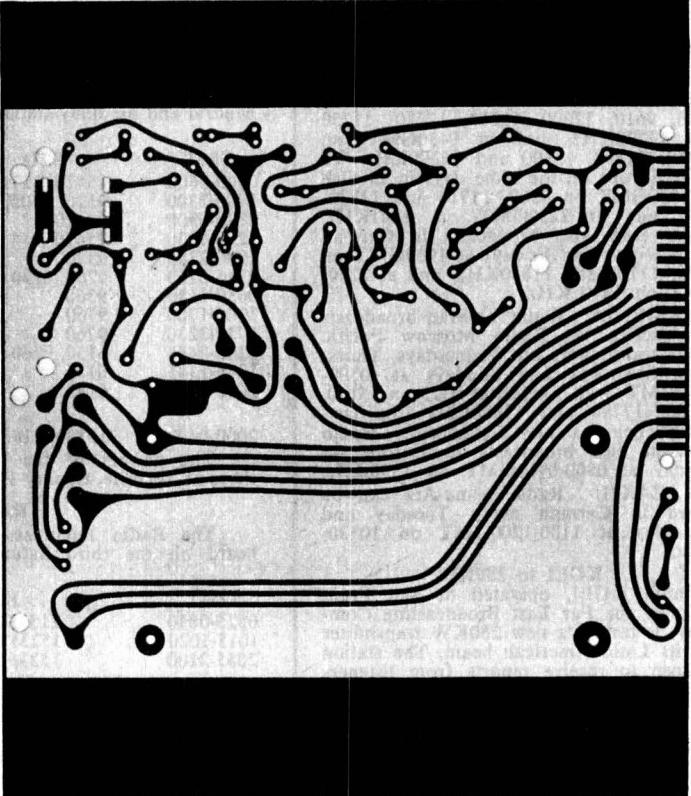
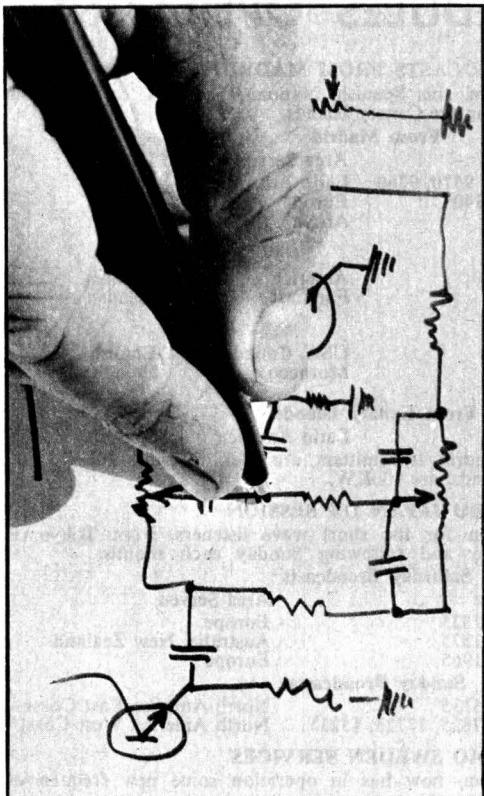
A schedule provided by the Technical Services of the Hellenic National Broadcasting Institute in Athens, Greece, lists the following transmissions in Greek.

GMT	KHz	Area Served
0700-0815	7295, 9605	Cyprus
0900-1000	9605, 11720	Egypt
1030-1300	7295, 9605	Cyprus
1330-1515	7295, 9605	Turkey and Balkans
1630-1700	7295, 9605	Cyprus and Near East
1730-1800	11720, 15345	France and England
1830-1900	7295, 9605	Cyprus
1930-2100	17720, 15345	N.W. Europe
2200-2230	15345, 11720	Mariners
2300-2330	15345, 11720	Mariners

ENGLISH BROADCASTS FROM ROME

Rome Radio has instituted some new frequencies for its English broadcasts to all areas of the world.

GMT	KHz	Area Served
0100-0120	11810, 9575	North America
1935-1955	11800, 9710, 7275	Great Britain
0425-0440	7275, 6075	Mediterranean
2025-2045	11800, 9575, 7345	Near East
2200-2225	15340, 11905, 9710	Japan, Australia
0350-0410	21560, 17795, 15340	South Asia



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your basic sketch, we offer far more than the usual follow-the-line translation of your ideas. As part of our complete service, STC engineers will check your design thoroughly, often suggesting improvements and modifications (if necessary) which can result in greater efficiency and savings in production cost. We can help design your own circuit from scratch. STC printed circuits are manufactured to world standards using the latest ITT equipment, and STC 'Epocor' epoxy/copper laminated

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world-wide communications and electronics



ALBANIA CHANGES

The signals from Radio Tirana, Albania, can still be heard on many new frequencies as they continue to look for clear channels for their transmissions. The English programs have also been altered in some of the transmission times, and the session previously heard at 2000GMT is now heard at 2030GMT on the new channel of 7135KHz. The Home Program from Radio Tirana is on 7065KHz and on medium-wave 1088KHz, at 1800-2200-GMT. French programs are on the air at 0500 on 6185KHz, and at 1500, 1800 and 2000GMT on 7265 and 9505KHz. The frequencies noted for transmissions from Radio Tirana have been 7090, 7125, 7305 9485, 11820, 11845 and 21435KHz, according to observations in Europe.

NEW CHANNELS FOR WARSAW

Radio Warsaw, in the transmission to Australia and New Zealand, has been observed on the new frequency of 11725-KHz, while 9525KHz is also being announced. Reception on 11725KHz is very good from opening at 0730GMT to the end of the English session at 0800-GMT. Programs then continue in Polish.

The transmission is also beamed for reception in the United Kingdom.

Opening announcements from Warsaw also list 11840, 9675KHz, both of which give fair reception, but the new channel of 9525KHz is blocked by Radio Netherlands in Hilversum for its service to Australia and New Zealand. The Polish Radio has also been observed at 2100GMT on 7145KHz at fair level with a program in Italian. The signals at this time suffer some interference from Moscow using 7140KHz, also with programs in Italian.

RADIO HAVANA, CUBA

The present schedule of Radio Havana, Cuba, for its broadcasts are as follows:

ENGLISH

GMT	KHz
2010-2140	17705
2050-2150	17815, 15285
0100-0450	9525
0100-0600	15285
0330-0600	11760
0630-0800	11930

ARABIC

0800-0830, 1000-1030	17885
1810-1850, 2030-2110	17885, 15365

KHz, is also announcing 870KHz and 4877KHz in its transmissions, while 6165KHz has also been heard with the same program. Further channels of 7175 and 9620KHz have also been received at 1600GMT.

LEBANON: As a result of recent changes by the Lebanon Broadcasting System, Beirut, transmissions to Africa are on the air at 1830 in English; 1900 Arabic; 2000 French on 21610KHz. The service to South America in Portuguese is at 2300GMT, Arabic 2330, and Spanish 0030GMT, on 17750KHz. North America transmissions are in French at 0130, Arabic 0200, English 0230, Arabic 0300, Spanish 0330GMT, on 15280KHz.

NOTES from readers should be sent to ARTHUR CUSHEN, 212 Earn Street, Invercargill, N.Z. All times listed are Greenwich Mean Time, add eight hours for Perth, 10 hours for Sydney and 12 hours for Wellington time. Frequencies are listed in Kilohertz (KHz).

The omnidirectional transmission 0430-0730 and 1625-1820GMT is on 5980KHz. From 0925-1600GMT, 9545-KHz carries this service in Arabic. The full schedule is now as follows:

GMT	KHz
1830-2030	21610
2300-0100	17750
0130-0400	15280

OCEANIA

WEST GERMANY: Deutsche Welle has made a frequency change for its German program to Australia and New Zealand from Cologne. The service is on the air 0645-0945GMT and the new frequency of 9650KHz replaces 21585KHz. The program is also carried on 11795 and 15205KHz at the same time. The service in English is on the air 0845-0945GMT and this is carried on 15275, 17845 and 21650KHz.

FRANCE: Radio ORTF, Paris, is using the new frequency of 15200KHz with sign on at 0230GMT. The station has the usual interval signal, and is heard with the same program on 11725KHz. Further transmissions are heard at 2300 and again at 0030GMT.

LITHUANIA: Radio Vilnius continues to provide good reception with the English language service to North America on Friday at 2230 to 2300GMT. The best reception is on 15215KHz. The station confirms reception by card and also send booklets on life in Lithuania.

GREECE: Radio Athens has introduced a five-minute news bulletin in English and French into the program schedule, which in the past has been in Greek for all transmissions. These bulletins are broadcast as follows:

GMT	KHz
0700	7295, 9605
1015	9605, 9710
1630	9605
1730	9605
1830	9605

MONACO: Radio Monte Carlo, the commercial service operating from Monaco, is on the air in French from 0500 to 0100GMT on long wave, and relayed on short wave, at 1800-0100 GMT, on 6035 and 7135KHz and from 2000GMT on 9655KHz. A mixed program in French and Italian is on the air 0600-1800GMT on MW 1466KHz and on SW 6035 and 7135KHz.

AFRICA

SOUTH AFRICA: The South African Broadcasting Corporation is expecting to put into operation before the end of the year five 100KW transmitters beamed to South-West Africa, and the North-Western Cape. The programs will be English and Afrikaans with separate frequencies for each service. The Springbok Commercial service will be added later.

CONGO: Radio Kinshasa is using the new frequency of 15245KHz from 2000GMT until KGEI San Francisco opens at 2230GMT. Radio Lumumbashi,

"The Voice of the African Brotherhood," can be heard in French at 1500 to 2100GMT using 11865KHz, according to "Sweden Calling DXers."

ANGOLA: The Emissora de Angola transmissions from Luanda is using a new schedule with programs in English and French on 9535 and 11925KHz. French programs are heard week days at 1000-1100 and 1600-1700GMT. On Sundays the session is at 0900-1000 and 1100-1200GMT. The English service is on week days at 1500-1600GMT and Sundays 1000-1100, and 1500-1600GMT. The latter service is not carried on 9535KHz. The station plans to change the frequency from 11925 to 11955KHz. In the past month, tests were also scheduled to begin with a second pair of 100KW transmitters, which will operate on medium wave 1088 and 1367KHz at night, and be on short wave during the day.

ASIA

MALAYSIA: Radio Malaysia, Kuala Lumpur, uses the new channel of 9660KHz for English programs from 1030 to 1630GMT, with news in English at 1400 and 1600GMT. The station is also on 7300KHz.

SOUTH VIETNAM: Radio VTVN, Saigon, which has been heard on 4897-

INDONESIA: A verification letter has been received from Radio Angkatan Udara. The station is operated by the Indonesian Air Force, and uses 11940-KHz from Jakarta. The power is 7.5KW and uses an inverted L-type antenna. The station operates at 0430-0730 and 0930 to 1330GMT in Indonesian. Programs include commercial broadcasts at 0630-0730 and 1000-1030-GMT. The address is 51 Jalan Tjipang Tjepedak 1, Djatinegara, Jakarta.

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Highett, Melbourne, Vic. 3190. Telephone: 95-4086.

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Prices range from \$19.00 to \$50.00 plus sales tax, if applicable. Pocket-sized, the instruments have features which enable electricians, service maintenance men and engineers to trace faults and investigate operating conditions without shutting down equipment.

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BROADCAST BAND NEWS

LORD HOWE ISLAND: Reception of Lord Howe Island Radio has been confirmed by Bob Padua, of Melbourne. Verification from the station shows the frequency as 640KHz and power as 50 watts. The supervising technician in charge says that the station provides information to residents on the arrival times of shipping and aircraft. The station was heard with this type of broadcast and confirmed reception on prepared verification card. Lord Howe Island is 800 miles north-east of Sydney and is under the control of New South Wales. The local time is 11 hours ahead of GMT.

SAUDI ARABIA: The Saudi Arabia Broadcasting Service has been heard on the new frequency of 1594KHz. Reception in New Zealand has been at 1945-GMT when a news bulletin in English is presented. At 2000GMT, time is announced as 11 p.m., and the next English news is scheduled for 5.15 a.m. the next day, which is 0215GMT. Saudi Arabia Broadcasting Service recently announced that new high-powered medium-wave stations were being installed. The reception of this frequency by Bill Woller, of Opunake, N.Z., has been at fair strength from as early as 1930GMT.

PORUTGAL: Radio Portugal has replaced two of its transmitters with units of higher power. The old transmitter on 755KHz of 100KW and 1061KHz of 135KW have both been replaced with new transmitters of 250KW each, according to "World Bulletin."

FIJI: The latest Fiji Broadcasting Commission station at Sigatoka is being received on 930KHz, both at opening at 1800GMT and closing at 1030GMT. Reception in both cases suffers interference from 3UZ Melbourne. The programs are in Fijian and Hindi. The station is using 2KW but this will eventually be increased to 5KW. The station, located 85 miles from Suva, is unmanned and uses a "T" aerial. Another new station for the F.B.C. is to be at Rakiraki, located on the northern coast of Viti Levu. This transmitter is expected on the air later this year using 1470KHz.

CANADA: The Canadian Broadcasting Corporation has cancelled its all-night programming as an economy measure. The stations in the major provincial capitals have been running an all-night music program from the Montreal studios, with news on the hour. The network was first put on to 24-hour-a-day operation for civil defence purposes. Many New Zealand listeners heard these signals in our evening, 910, 990, 1010 and 1550KHz being the best received.

HIGHER POWER: Radio Peking has boosted the power-output of its Urumchi station on 1525KHz to 8,000KW. This is used for Russian to Europe in the evenings. Radio Kuwait has launched a 750KW transmitter on 539KHz. Saudi Arabia, broadcasting on 647KHz from Rivadh, has the power of 2000KW according to "Sweden Calling DXers."

PHILIPPINES: A verification has been received from DXOC on 1490KHz, which has been heard around 1500GMT. The station is one of the Filipinas Broadcasting Network Inc., which operates the following stations.

Call	KHz	Location
DZRC	890	Lagaspi City.
DZGE	850	Naga City.
DZEB	1200	Naga City.
DXOC	1490	Ozamis City.
DXGS	750	Rajah Buayan City.
DZNT	1120	Tarlac, Tarlac.
DZCV	750	Tuguegarao.

ANSWERS TO CORRESPONDENTS

When writing to us:—

- Please give your name and full postal address, including the State.
- Write the above information clearly or, for preference, print it in block letters. Your co-operation will facilitate delivery of replies by mail, where such are called for.

DANGER SIGNALS: I was very interested in the articles on model train controls and intend constructing one of these. However, I must strongly protest against the frequent use of the phrase "danger signal" in the January, 1968, article. This phrase will horrify all railway enthusiasts because, of course, there is no DANGER signal on any railway. A coloured light showing red, or a semaphore at the horizontal, is a STOP signal not a danger signal! In answer to your correspondent, B.W., Bald Hills, Qld., in the February, 1968, issue, may I suggest that he adopts my plan which is to buy two copies of each issue. One he can keep intact in his files, and the other he can tear up at will to isolate such articles as interest him. (L.T., Port Kembla, N.S.W.)

● We feel sure that the phrase "danger signal" was in use in our days of youth, at least among old-time railwaymen in the country. However, we will accept your criticism as valid, although we must point out that you are the only "horrified" enthusiast to protest against our use of the phrase. A cheaper method than buying two copies of Electronics Australia might be to request a copy of one article through our information service on the occasions when we print two wanted articles back-to-back.

UHF RECEPTION: Please could you explain the operation of a UHF aerial. I would also like to know about the equipment needed for UHF reception as I am interested in radio astronomy. (M.S., Mt Kuriling-gal, N.S.W.)

● The basic principles of UHF aerials are the same as those for aerials covering other frequencies. However, the shorter wavelengths make practicable many configurations which would be clumsy or completely impractical at lower frequencies. We have never discussed this subject, or radio astronomy, in detail and so regret we cannot help. We can only suggest you refer to nearest large public library or bookstall for suitable reference texts.

SONAR GUN: I want to undertake a project, but do not know how to go about it, and am seeking your help. I would like to build a "Sonar Gun" — an instrument that would produce a very high frequency noise sufficient to crack a piece of wood or stone, without really disturbing human hearing. If this is possible, would you please forward the necessary information. (A.S., East Prahran, Vic.)

● A device such as you describe could probably be made, but we have never described such a project, nor do we consider it a suitable one for home constructors. As far as safety is concerned, it seems likely that something powerful enough to do what you have in mind would be a first order hazard to human ears!

BOUQUETS: I must commend you on such a magnificent magazine. I have not yet finished my first twelve months subscription but have already renewed for a further period. I have only been interested in electronics for about 12 months but have increased my knowledge considerably, with the further aid of a Philips kit. I have constructed a small radio which can be

adapted for a variety of other purposes and could produce the plans for "Reader Built It." (S.K. 14yrs., Mentone, Vic.)

● You seem to have been making fine progress. Congratulations. We are happy to consider submissions for "Reader Built It" and will pay for contributions used. The contributions must describe equipment actually built by the correspondent and, of course, capable of operating in a satisfactory way.

When writing, please make sure your address is complete, including the POSTCODE. Addition of the latter will ensure minimum delay in handling your letter. Also make sure that your address is legibly written or, for preference, PRINTED. A significant number of letters are returned to us each month because the original address was incomplete or illegible.

BEGINNERS' PROJECTS: Even though I have not been a reader of your magazine for long, I have found it very informative. However, I do think that more beginners' projects using components salvaged from old radios, etc., would be appreciated. Also I would like to see an article on how to become a radio amateur. (A.B., East Merton, Vic.)

● We publish articles for beginners from time to time, but we must cater for a wide range of reader tastes. A number of past beginners' projects are available through our Information Service for a fee of 20c each if you care to be more specific in your requirements. If you are interested in

becoming a radio amateur, we suggest that you contact the Wireless Institute of Australia (Vic.), P.O. Box 36, East Melbourne, Vic. 3002. In addition, there is a chapter on Amateur Radio in our "Basic Radio Course" book, which you can obtain from our office for \$1.60 posted.

FERRITE ROD AERIAL: If an aerial coil on a ferrite rod is justified in a design such as a small regenerative receiver (e.g. 2-transistor all wave receiver, June, 1960), why don't you use it regularly in your designs instead of an open coil on a 1½in former? (M.T., Bondi Junction, N.S.W.)

● You will find, M.T., if you check through our designs, that we normally use commercially made coils which include a ferrite or similar core. However, occasionally we use open coils for short-wave receivers where there is no commercial coil design suitable for the circuit's requirements. In the case of a receiver with regeneration the losses in the coil are largely overcome by the positive feedback and the use of a ferrite core in this case gives little advantage.

WOW PEDAL: Having several guitarist friends I am regularly called upon to try to simulate some effect which appears on a new record. I noticed with interest, therefore, a letter from P.M., North Balwyn, Victoria. This particular "wow pedal," otherwise called "wah-wah" or "cry-baby" pedal is a kind of variable frequency resonant circuit tunable from about 400Hz to 3KHz. An L.C. circuit is, of course, impractical due to the low frequencies involved. However, I am at present working on a parallel-T rejection circuit as negative feedback loop. When (and if) I get some sense from the "wow pedal" I will send the circuit to your "Reader Built It" page. (L.C.W., Christchurch, N.Z.)

● Many thanks for your comments, L.C.W., which we are publishing for the benefit of other interested readers. Also we will be happy to consider your contribution to the "Reader Built It" page when you have the system working. Inci-

"ELECTRONICS Australia" Information Service

As a service to readers "ELECTRONICS Australia" is able to offer: (1) Photographs, dye-line prints and other filed material to do with constructional projects and (2) A strictly limited degree of personalised assistance by mail or by reply through the columns of the magazine. Details are set out below:

REPRINTS: For a 20c fee, we will supply circuit data, as available from our files. The amount of data available varies but in no case does it include material additional to that already published in the magazine. For complicated projects involving material extracted from more than one issue, an extra fee may be requested. As a rule, requests for circuit data will be answered more speedily if the circuits are positively identified and the request is not complicated by questions requiring the attention of technical personnel. Where articles are not on file, we can usually provide a photostat copy at 20c PER PAGE.

PHOTOGRAPHS, DYE-LINE PRINTS: Original photographs are available for most of our projects, from 50c plus 8c postage for a 6in x 8in glossy print. In addition, metalwork dye-line prints are available for most projects for 50c each; these show dimensions and the positions of holes and cut-outs but give no details of wiring.

BACK NUMBERS: A fairly good selection is available. On issues up to 6 months old there is a surcharge of 5c. On issues from seven to 12 months old the surcharge is 10c. Over 12 months, it is 20c. Package and postage is 10c extra in all cases.

REPLIES BY POST: This provision is made primarily to assist readers in matters relating directly to articles and projects published in "ELECTRONICS Australia" within the last 12 months. Note, however, that we cannot provide lengthy answers, undertake special research or modifications to basic designs. A 20c query fee must be enclosed with letters to which a postal reply is required; the inclusion of an extra fee does not entitle correspondents to special consideration.

OTHER QUERIES: Technical queries which fall outside the scope of "Replies by Post" may be submitted without fee and may be answered through the columns of the magazine at the discretion of the Editor. Technical queries will not be answered by telephone.

COMMERCIAL EQUIPMENT: "ELECTRONICS Australia" does not maintain a directory of commercial equipment, or circuit files of commercial or ex-disposals receivers, amplifiers, etc. We are therefore not in a position to comment on proposed adaptation of such equipment, or on its general design. "ELECTRONICS Australia" does not deal in electronic components. Prices, specifications or other assistance must be sought from the appropriate advertiser or agent.

REMITTANCES: These must be in a form negotiable in Australia. Where the charge may be in doubt, an open cheque, endorsed with a limitation, is recommended.

ADDRESS: All requests for data and information, as set out above, should be directed to The Assistant Editor, "ELECTRONICS Australia," Box 2728 G.P.O., Sydney, N.S.W., 2001. Other correspondence should be directed to The Editor.



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Good tone. Attractive plastic cabinets \$23.50

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MR3-P 0-500 microamp 3½in x 3in	\$5.35
MR3-P 0-1 milliamp 3½in x 3in	\$5.35
EW16 0-1 milliamp 3½in x 1in (edge reading)	\$6.00
MR2-P 0-500 microamp 1½in square	\$3.50

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Type SO45— 1 7-8in square

0-10, 0-20, 0-30, 0-40v AC/DC.

0-1, 0-5, 0-20 Amps AC/DC, \$3.20.

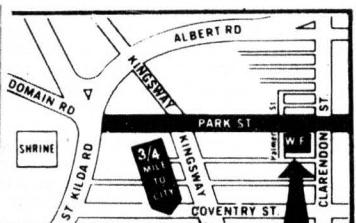
Type SO65, 3½in Round 0-300v AC/DC, \$4.



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ANSWERS TO CORRESPONDENTS - continued

dentially, another reader's explanation for a wow pedal is that it is simply a heavy top-cut tone control. The one he has is a tone control potentiometer operated by a spring-loaded foot pedal. Pumping it up and down gives the requisite sound to wow the listeners!

LOOKING BACKWARDS: Looking back through some old issues of "QST" I came across an editorial in February, 1926, itself looking backwards. I wonder if it would be of interest to readers of "Electronics Australia." (L.N., Morphettville, S.A.)

• Possibly it could, and we have filed it for use, if space should become available. We well know the lure of looking back, particularly if one has some memory of the times involved. One can easily get completely taken up by magazines dating back to the twenties, when radio was so young.

TEST EQUIPMENT: Could you please settle an argument with regard to the "Baby Stereo Amplifier" described in May, 1964, and also other equipment which you describe for younger readers like myself. All the people I have consulted say that, to construct even these basic circuits, I would have to buy hundreds of dollars worth of test equipment before I could safely plug them in. If so, could you please advise me what test equipment I would need? Yours is a great magazine. The "Basic Radio Course" is especially good. (F.H., Forest Hill, Vic.)

• We're not quite sure who your advisers would be but they either didn't know or they were pulling your leg! If a person had all that test equipment and knew how to use it, they wouldn't need to build simple tuitional projects. Many of our readers have started with nothing but a few tools and a cleared spot on the kitchen table. Nowadays, a greater proportion can afford to add a simple multimeter, by reason of the fact that they are available quite cheaply. Be assured, plenty of our simple projects, and even a lot of the not-so-simple projects can be built without test equipment, provided you follow the instructions implicitly.

ELECTRONICS IN PHOTOGRAPHY: Reference to a recent request for a "light meter tester." I would like to add my request for this, in the hope that there may be "sufficient demand" to justify considering it. Concerning electronics in photography generally, I have noticed that my friends in the electronics business make photography their favourite hobby, while among "pro" photographers (I am one) electronics seems to be the most popular form of escape. I suggest that you continue to provide articles covering electronics in photography. A few suggested ideas: "Update That Old Flash Unit," "A Simple Shutter Speed Tester," "Build Your Own Exposure Meter," "Exposure Meter For Flash." I suggest that any photographic articles be checked by an experienced, practising, professional photographer. That Photo-Timer! Who but a new dilettante would want exposure times of 22 seconds, 16 seconds, etc., marked? Darkroom confusion. (R.F., Panania, N.S.W.)

• Thank you for adding your request for an exposure meter tester to the previous one. We will see what other response we get. We have noted your other suggestions and will keep them in mind for future consideration. However, there may be grave doubt about the economics of a home-made exposure meter, while we question whether there is such a thing as a "simple" shutter speed tester. In regard to the timer, we can only express confusion by your comments, since you have not bothered to state precisely why you feel that certain times would be required only by a "raw dilettante" (we presume you mean amateur). We don't mind criticism, but we like it to be lucid. Inci-

dentially, the basis for the timer design was discussed in detail in the July, 1964, issue preceding the constructional details in the August, 1964, issue.

TUNER/AMPLIFIER. I am a recent subscriber to "Electronics Australia," which I enjoy very much. I would be most interested in a series of construction articles describing a receiver, incorporating some of the refinements of communication receivers and giving good SW listening facilities, in conjunction with a fairly modest stereo amplifier. (G.D., Kalkoura, N.Z.)

• We are of the opinion (supported by a lack of similar requests) that the majority of our readers prefer to keep their short-wave listening separate from their hi-fi listening. Therefore, we have never developed, or considered, a combined design such as you suggest. The only combined tuner/amplifiers which we have published (Playmaster 106 of December, 1963, and Playmaster 107 of March, 1964) covered only the broadcast band. Alternatively we suggest that one of the recent series of tuners be used with one of our latest stereo amplifiers, such as the Playmaster 115 of April, 1967, or the Playmaster 118 of July, 1967. Copies of all these articles are obtainable through the Information Service for 20c each. If you are still keen to pursue your suggested course, you could combine the front-end of one of our recent "All-wave" series of receivers with a stereo amplifier.

TAPE ADAPTER TROUBLE: I have completed the Playmaster 119 Stereo Tape Adapter of September, 1967, but have an annoying problem. When I switch to record through either channel, both level meters swing hard over even with the volume controls turned right down. I have tried increasing the meter series resistors but this only reduces the reading slightly without producing normal meter operation on signal. Can you offer any assistance? (J.K., Mosman, N.S.W.)

• The most likely cause of your trouble is bias injection into the recording amplifiers or metering circuits, due to unwanted coupling from the bias/erase wiring either at the oscillator itself or at the function switches. The cure may involve nothing more than re-routing some of the leads to reduce the coupling; otherwise you may have to add extra shielding. Apart from upsetting the level meters the injected bias will probably be causing distortion, giving a second reason why you should remove the cause before attempting to make serious recordings.

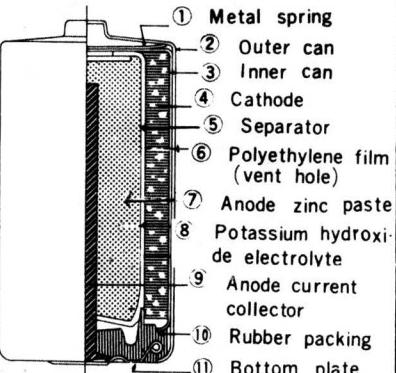
USING TAPE RECORDERS: Would it be possible to produce an article or articles on using tape recorders. The novelty soon wears off recording voices at a party. Very few people want a stereo recorder but more could put them to better use if they knew how. What about a time switch to record programs that are broadcast at a time when you are not at home. A tape recorder could possibly be used to record something that would otherwise require a pen recorder. Then there is the question of monitoring using an extra head and methods of editing tapes. Perhaps I have asked for a book! (S.F., Newcastle, N.S.W.)

• Your suggestions, which we have merely summarised, are good ones but you are right in suggesting that they would call for a book. One also runs very quickly into the problem that non-technical people, who need to be told how to do some of these things, lack the ability to carry out the necessary instructions. There are so many different items on the market that readers can only be given general instructions and these are often just not enough for people who are peering into the works of a receiver or tape recorder for the first time.

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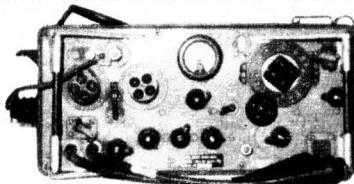
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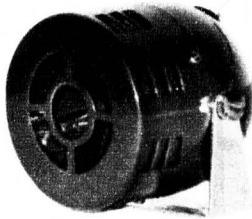
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0-140V
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150V Range)
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Accuracy: within +/- 5% full scale

Freq. Response:

30 c/s-500 Kc within +/- 3% 20 c/s-
10 Mc within +/- 10%
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0.1V-0.5V 0-15V 0-50V
0-150V 0-500V 0-1500V

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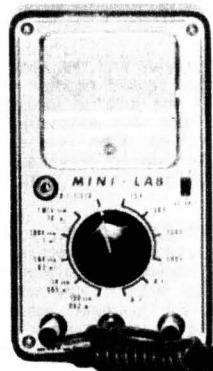
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Capacitance Substitution: Five values: .002ufd, .005ufd, .02ufd, .1ufd (oil) at 600V and 10ufd (electrolytic) at 350V.

R.F. Signal Generator: Frequency: Fixed at 455kc (up to 700kc adjustable). Output: 35mV (approx.).

Audio Generator: Frequency 400 c/s (approx.). Output: 35mV (approx.).

DC & AC Voltmeters: Meter Movement: 0-200uA. Input Resistance 4,000 ohm/volt. Four Ranges: 0-15 0-50, 0-150 and 0-500V. Accuracy: +/- 5% of full scale.

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Weight: 570 grams. Size: 6" (W) x 2 3/4" (D) x 3 3/4" (H).

Accessories: The unit comes with test leads, an antenna and battery.

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Track System 2 Track Monaural,
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Tape Speed 1 1/2 ips, in continuous use.
Battery Life 10 hrs. in continuous use.

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Transistors 8 Transistor & 1 Diode.

Recording Method AC Bias 40 Kc.

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Frequency Response 150-8000 c/s +/- 5db.

S/N Ratio More than 40db.

Wow & Flutter Less than 0.4%.

Dimensions 5" x 9 1/2" x 2 1/2".

Weight 2.9lb w/o batteries.

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\$65 inc. Tax

ANSWERS TO CORRESPONDENTS—continued

DESIGN SUGGESTIONS. Regarding a light meter tester as mentioned in your "Answers to Correspondents" pages, I too would be very interested in such a design. Even better would be a combined light meter and tester which could be used in the field. Would you consider including in your magazine a section on designing your own receiver or amplifier, with the emphasis on calculations required to establish the values of components used in these equipments? Congratulations on your excellent magazine—I look forward to its issue every month. (B.H., Nunawading, Vic.)

• We note your comments about the light meter tester, and will give the idea due consideration. However, we feel bound to ask why it is felt that such a device need be sufficiently portable to use in the field. We can understand the possible need for such a device on the work bench, assuming that service of these devices is contemplated, but we are at a loss to understand why they would be needed on any other basis. Most light meters, once calibrated, should hold their calibration for a long time, barring accidents or damage. As far as the tester itself is concerned, it may well be that most requirements would be satisfied with nothing more than a standard lamp (probably a daylight type) built into a simple jig which would maintain a calibrated distance between it and the meter under test. We note your other suggestion regarding design articles but wonder whether you realised how extensive a thorough series would need to be.

ELECTRONIC ORGAN: I would like to see a series of organ articles using the latest available transistors and printed circuit techniques. This does not mean that you must get down to details like the last nut and washer but an organisation such as yourselves has a good chance of making the best use of such things as ICs in dividers, etc. (P.P., Collingsville, Qld.)

• There are probably a number of projects we could tackle if we were to give them complete priority over everything else—and suffer the consequences. To design, build and test a complete, original and up-to-the-minute electronic organ would probably involve a year or more of time of a senior staff member, during which time he could contribute very little to the pages of the journal. Add the time it would take to prepare and present the articles, after the instrument was finished, and it works out at a rather staggering wage-bill for half a dozen articles. A further consideration is that only a limited number of readers would be likely to make practical use of the articles, since commercial electronic organs are so plentiful in this country, both new and traded in. The most likely basis on which we, or any other comparable magazine, are likely to feature the construction of an organ is when we are able to tie-in with a kit proposition; or when the articles are offered by a contributor or a dedicated staff member who has constructed an instrument in his own time for his own purposes. Then we can pay an appropriate contribution fee without having to meet development costs on a man-hour basis. We know of a couple of possibilities along this line but they are quite vague at the moment.

RADIO CONTROL: Like R.A. of Lindfield (Answers to correspondents, June 1968) I am a radio control aeromodelling enthusiast, an activity that appeals to me as a practical application of both aerodynamic and electronic theory. I would certainly appreciate your consideration of a future project for a multi-channel digital proportional control system, but using locally available components. (T.B., Moonee Ponds, Vic.)

• We would dearly like to be able to

promise you something along these lines but this is a very specialised field which demands a lot more than the ability to set up a radio link. The whole concept and design has to be integrated with the control philosophy and this demands, in turn, that the person responsible have a first-hand knowledge of the subject and a thorough background in what aeromodellers are currently doing and thinking. This, incidentally, is subject to fairly rapid and extensive changes, related to overseas developments and equipment. If a member of our technical staff was an avid aeromodeller, there would be less of a problem but, such is not the case at the moment. Be assured, however, that if the opportunity occurs to present something along the lines of your request, we will be keen to grasp it.

TUNNEL DIODES: I am submitting the circuit of a three-transistor amplifier which I have built. It has problems of microphony due to high amplification. The load is a 100-ohm loudspeaker and the microphone a 2000-ohm earphone. Also, please explain what a tunnel diode is. (R.M., St. Albans, Vic.)

• Our tip is that your trouble is not microphony but the usual tendency for a loudspeaker to feed back into a microphone when the two are operated in any sort of proximity. Extend the loudspeaker

leads and operate it in the next room with the door closed. You may find that the effect then disappears or is greatly diminished. Acoustic feedback is particularly likely to be troublesome when the microphone has a peaky frequency response and this would almost certainly be the case with an earphone used in this role. Articles on the tunnel diode appeared in February and September, 1961. A tunnel diode almost defies description in simple terms. Basically, however, both sides of the P/N junction in a tunnel diode are very heavily doped. In the forward bias region, the current rises very rapidly as the voltage is increased, so that a tunnel diode passes current at a voltage so low that the usual diode would still scarcely be conducting. However, as the voltage across the tunnel diode is increased, the current rises to a peak, then falls to a trough and finally rises again towards the point of ultimate saturation. This rather strange inverse relationship between voltage and current produced what is called a "negative resistance" characteristic; the precise reason for the current behaving in this fashion is not fully understood but it has been described as "tunnelling," a word that is more expressive than meaningful. By forward biasing a tunnel diode so that it operates in the critical negative resistance region, it can be associated with other components to act as an amplifier or oscillator or as an electronic switch capable of changing its state more rapidly than almost any other electronic device.

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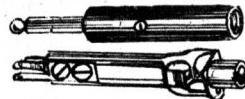
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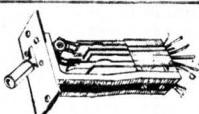
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ANSWERS TO CORRESPONDENTS—continued

VARICAP DIODE: I have been a regular reader of "Electronics Australia" for more than six years and, although I am not a practical hobbyist, I do enjoy the general articles, discussions, features, etc. Usually, we are kept well informed on matters electronic but I recently read elsewhere about a device called a "varicap" diode. Several manufacturers have adopted it for VHF and I believe that it can be used also for medium-wave bands. I would like to see an article on the subject in E.A. Surely the discarding of an old faithful component like a tuning capacitor is worthy of some comment? Another thing: With the world so full of sophisticated electronic equipment of supposedly fantastic accuracy, how is it that nuclear subs vanish without trace? A destroyer captain is misled into thinking that his ship is being attacked? Contour-following aircraft have crashed? I shall look in the July issue for your explanation. (S.C., Clayton, Vic.)

• Taking the points in your letter somewhat out of order, we can't guarantee to include an answer in any particular issue. They are simply dealt with in rotation and included as space becomes available in successive issues. Why did all these things happen? Possibly because of an electronic malfunction, or because of a human or mechanical failure to make proper use of the electronically derived information. While it is certainly possible to point to failures, don't forget the countless occasions on which the equipment does not fail. This is tantamount to saying that electronic, mechanical and "human" equipment is not yet 100 per cent reliable. As for the varicap diodes, we are pretty certain that they have been mentioned in various ways at various times. We used one in the Sweep Generator, December, 1963; the SSB Transmitter, January, 1967 and the 1967 All-Wave-Receiver, December, 1967. It is going too far to suggest that varicaps have displaced the time-honoured variable capacitor. They are very useful for certain applications and may have displaced the variable capacitor in a few. Their possibilities are also increasing as their development progresses but there are still plenty of situations where the tuning capacitor is the better proposition.

32-VOLT EQUIPMENT: Being miles from AC mains and one of the many still relying on 32V power, a project or two suitable for use on this voltage would be appreciated. With the many new solid-state devices now available, I feel sure that a 32V mains receiver and a stereo power amplifier would be of interest to many. I have been a constant reader of your magazine since 1946. (R.F., Augathella, Qld.)

• Even at its peak twenty years ago, 32V equipment was marginal as a basis for home constructed receivers and amplifiers. It was not just a question of how many 32V systems were in use but how many users of such systems could build—or have built—projects described in a magazine. Nowadays, unless our impression is badly astray, the number of 32V systems in use would be much lower than it was in January 1950—the date of our last 32V receiver project. As far as stereo amplifiers are concerned, the present position should be far easier than it has ever been, in that most of the amplifiers for construction or on sale are intended to operate from an internal DC supply of 20–25V. It should be a relatively easy matter to substitute for the mains transformer and rectifier a suitable dropping resistor to feed the existing filter. If over-voltage is likely to be a problem, the regulating section of a regulated power supply could probably be inserted as the link between the line and the amplifier. As far as dual-wave receivers are concerned, these have largely dropped out of the project scene, irrespective of supply volt-

age, having very largely been displaced by imported multi-band portables. At present, it is not even possible to buy prefabricated dials and coil brackets, these having been dropped from the market for lack of demand. Perhaps it is appropriate here to ask how many other readers are interested in building or adapting equipment for 32V supply systems.

TRANSISTOR RADIO. Recently my father bought me an electronics set, and after building all the sets up to the largest—using three transistors—I feel that I need something larger. I would be pleased if you could advise me as to where I can obtain circuit diagrams for a four to six transistor radio. (S.T.K., Kenmore, Qld.)

• We have described several transistor radios using four to six transistors. One was published in November, 1966, titled "A Simple Receiver of Novel Design," and another in October, 1958, titled "Transportagram Six." There was also a seven transistor set in December, 1963, titled "Transporta Seven." Copies of these articles may be obtained from the Information Service for the usual fee of 20c each.

PHOTOGRAPHY AIDS. I wish to build a battery capacitor photographic multi-flash unit capable of firing up to six flash bulbs in series. It should be complete with test circuits to determine whether the capacitor is charging satisfactorily, the continuity of each flash bulb filament, the operation of the camera flash contacts and the resistance of the complete series flash bulb circuit. I also wish to construct a control device to maintain the temperature of an eight gallon water bath to within $\pm \frac{1}{4}$ deg C over the range 20–25 deg C for processing colour films. The power consumption would be around about 200 to 300 watts. If you have published suitable circuits for these two jobs in the past, would you please give me the references so I may order reprints. If you have not treated these subjects you may care to consider featuring them in the future. Photography is a hobby which I imagine would rival electronics in popularity and I am aware that from time to time you have included articles on electronic flash units, timers, etc. I suggest further articles on the application of electronics to photography would be eagerly read by a wide circle of serious photographers. Other subjects which come to mind are stroboscopic devices for taking multi-image photographs of moving objects, light beam shutter trips for natural history photography, constant voltage sources for colour enlarging, exposure meters, colour temperature meters, enlarging meters, densitometers, and many others.

• A multiple flash unit for flash bulbs is rather specialised and we would need to be convinced that there is sufficient demand for such a unit before considering undertaking the development of it in our laboratory. We are currently working on a temperature control circuit, using thermistors, and we hope to publish something in the near future. However, it must be realised that the mere provision of a temperature-sensitive switch is only a small part of the problem. Even distribution of heat and minimum thermal resistance between the heat source and the solution to be controlled are essential if the system is to work satisfactorily. However, our circuits may provide a basis for experiment. Some of the other ideas you suggest may also be rather specialised, or too difficult for the home constructor, but we will keep them in mind. The constant voltage source, in particular, may be worthwhile, while we have already described several light beam systems, including an infra-red version, which could form the basis for the natural history photography.

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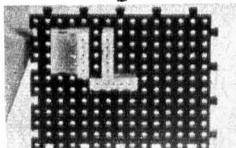
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WORLD WEATHER WATCH

(From page 21)

meteorological centres with computer facilities will be established to serve groups of nations. One such centre in Miami, to serve Latin America, has been proposed by the United States. Consideration also will be given to a new multipurpose satellite capable of point-to-point weather data communication, collection of weather data from surface and upper-air stations, and global picture coverage.

The World Weather Program will increase the weather services available to the community of nations, according to D. A. Davies, Secretary-General of the W.M.O. "However, the undertaking is much more than a purely scientific endeavour—it also involves many practical aspects which are expected to bring significant economic, social, and other benefits to its supporters and to the world as a whole."

These benefits depend on weather forecasting. A knowledge of future weather conditions is important for maintaining the health of a nation's economy. Safe and economic operation of ships and aircraft depends on weather forecasts. The daily operation of large dams calls for decisions on how much water should be released for hydro-electrical power generation, irrigation, and flood control. Snow and rain forecasts upstream from such dams are crucial to making these decisions.

Weather forecasts are equally important to all farming operations. Being able to anticipate weather that affects building and road construction leads to obvious economic benefits. In fact, any economic activity of man that is weather-sensitive can benefit from improved forecasting. The objective envisioned by meteorologists is an accurate two-week forecast. Further downstream in time, the day may come when man's knowledge of the weather will be so complete that he will be able to control it much as he has learned to control some of nature's other resources. ■

DOCUMENTARY RECORDS

(From page 101)

skill. The mode of delivery is not unlike an incantation, (sometimes in a half whisper), and the aim is to induce in the listener complete relaxation from head to toe. Does this kind of thing lose something in translation—"Have that wonderful, wonderful feeling of well-being as taut muscles relax" is close to the jargon used in commercials for patent medicines.

Side 2 brings a change of voice, a woman's voice this time, just a shade less fetching than the anonymous gentleman on Side 1, but every bit as professional. Harp glissandos set the scene, and after having been physically "relaxed" by Side 1 we now hear a discourse on Mental Relaxation.

I am inclined to think that the whole presentation is a westernised version of the Yoga philosophy. However, if you have a mind for non-violent exercise and consider that to relax and meditate is as good a way as any of exercising, then this record is for you. I personally find that some of my poetry records are just as soothing and lying on the floor listening to a Mozart piano concerto can be remarkably relaxing, too. ■

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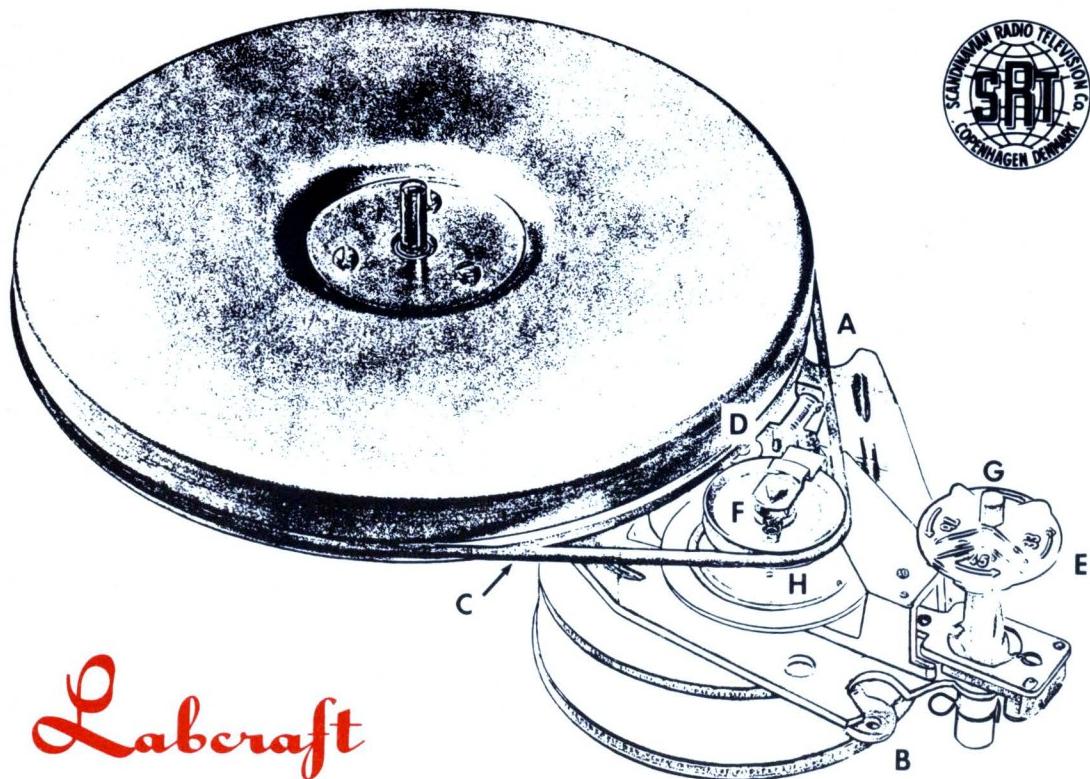
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Labcraft

Why pay more? Take a look under a Labcraft 605 turntable, see how the motor is suspended on three radial springs terminating at A, B, and C; any vibration is isolated. The stepped pulley on the motor shaft (D) engages the specially ground rim of the idler wheel (H) which can be raised to a larger step by means of speed change dial (E). The idler belt pulley (F) is of large diameter and the shaft is ground to an extremely fine tolerance to ensure smooth running. The belt (made of a special synthetic

- not ordinary rubber!) is soft and round and so gentle that the turntable is turned to perfection. A Labcraft is lubricated in the factory for years of playing, and don't forget the speed adjustment knob (G) which enables you to make a fine adjustment to the speed anywhere within the range of $\pm 10\%$ of nominal.

Labcraft quality record players are imported by the sole Australian Agents G.R.D. Instruments Pty. Ltd. of 6 Railway Walk, Camberwell, Victoria. They are intended for use in the high-

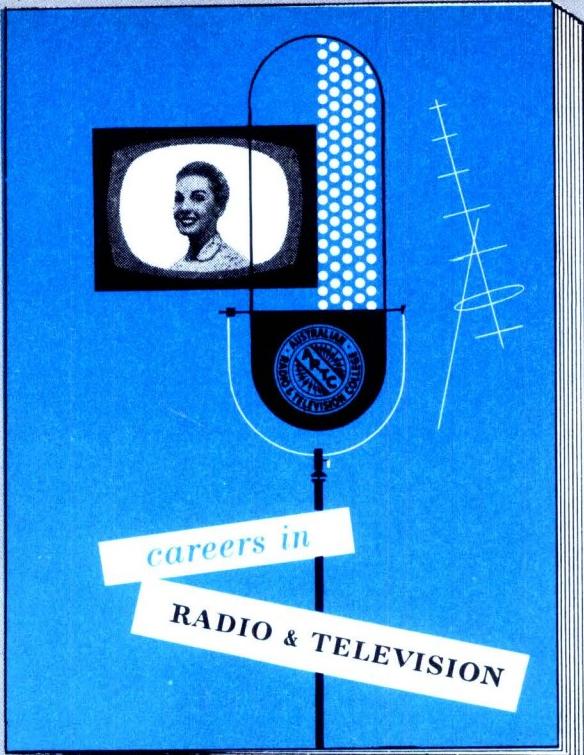
est grade stereo systems to give reproduction free from rumble, wow or flutter. Several models are available; model 605 fitted with STL 25° arm and B&O stereo magnetic cartridge is particularly good value as a record player for serious listening to music for those who are building up a system on a budget. Model 605L is the popular model with 12 inch mat. Model 655 is the deluxe model and 665 is an automatic turntable. Be wise and choose Labcraft; yes indeed - why spend more?

G.R.D

Listed below are examples of Retailers of Hi-Fi- equipment who are able to supply your labcraft turntables:-
Melbourne: Danish Hi-Fi Pty. Ltd., J.H. Magrath & Co., Thomas', Hannams, Elanco, Douglas Trading, William Willis, Max Rose, Suttons, South City Electrics, Myers, Windsor Hi-Fi, Warburton Franki, S.T.A. Electronics, Radio Parts, McPhersons Hi-Fi Centre, Malvern Star Stores, D.G. Lockwood & Co., Homecrafts, General Accessories, Aust. Musical Industries,

Aust. Sound & T.V., Douglas Radio, A.W.A., E & S Trading, Rekla Electrosound, Vealls, Brashs, Adelaide: Macks Electronics, Newton McLaren Ltd., Truscott Electronics. Canberra: J.B. Young Perth: Carlyle & Co., Les Leonard, Atkins (W.A.) Ltd., Alberts T.V. & Hi-Fi, General Accessories. Sydney: Wedderspoon & Co., United Radio Dist., Arrow Electronics, Asdig Stereo, Broadway Electronics (Sales), A. Victor & Co., Radio Despatch Service, General Accessories.

Newcastle: Martin de Launay, Lawrence & Hansen. Brisbane: Brisbane Agencies, A.E. Harold, C.A. Pearce & Co., Trackson Bros., Chandlers, Chas. Croker, (Mackay). Darwin: Pfitzners Music House. Launceston: W & G Genders Pty. Ltd. Hobart: Homecrafts Albury: Proust-Albury Bathurst: Dickins and Carey.



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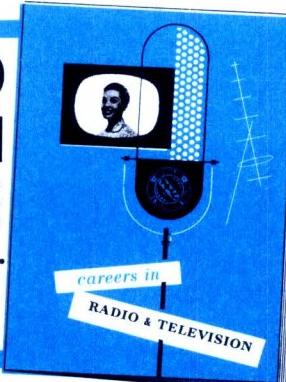
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